

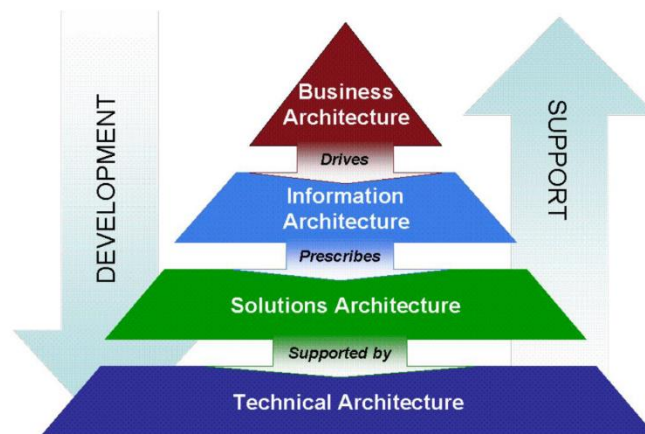


Enterprise Architecture Technical Brief

Converged and Hyper- converged Infrastructure

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January 2019





Enterprise Architecture Converged and Hyper-converged Infrastructure

Summary

This technical brief defines the meaning of converged and hyper-converged infrastructure technologies while identifying the pro's and con's of each.

Guidance from this technical brief is intended to help commonwealth agencies determine which, or both technologies will be useful for them.

TechTarget defines these two infrastructures as:



Converged Infrastructure:

“An approach to data center management that seeks to minimize compatibility issues between servers, storage systems and network devices while also reducing costs for cabling, cooling, power and floor space.²”



Hyperconverged Infrastructure:

“A type of infrastructure system with a software-centric architecture that tightly integrates compute, storage, networking and virtualization resources and other technologies from scratch in a commodity hardware box supported by a single vendor.³”

For any comments, questions, and/or concerns with this technical brief, please contact VITA EA:
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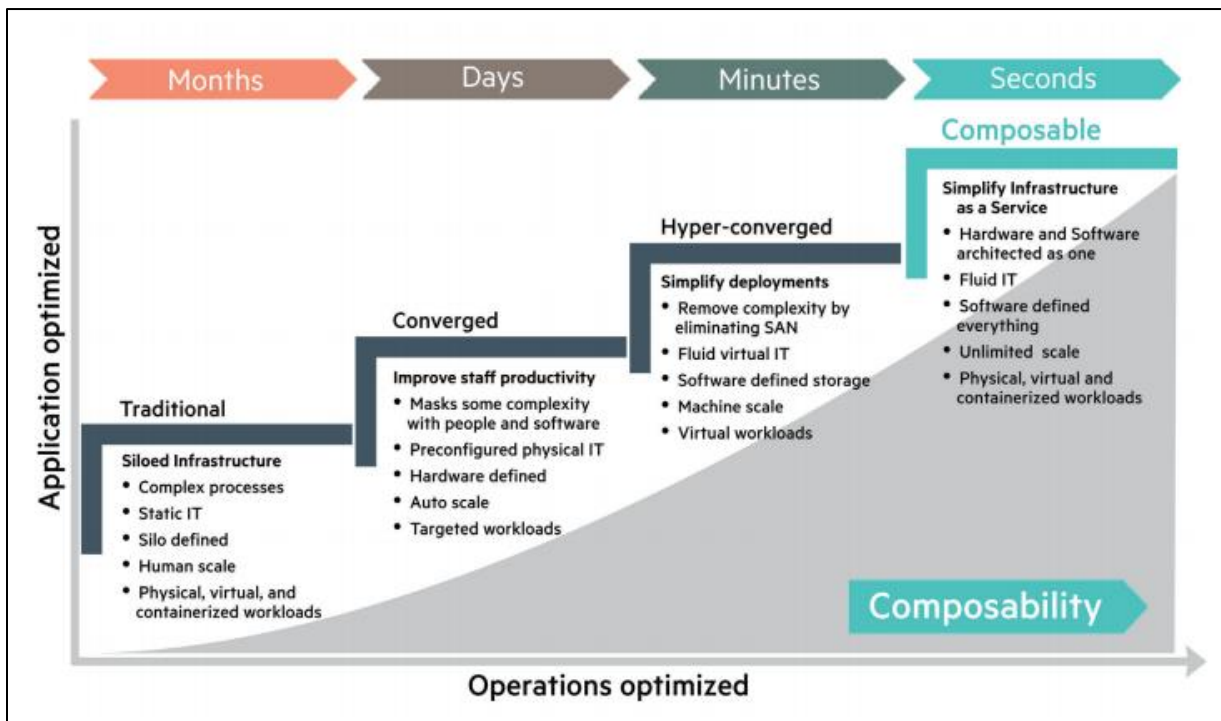
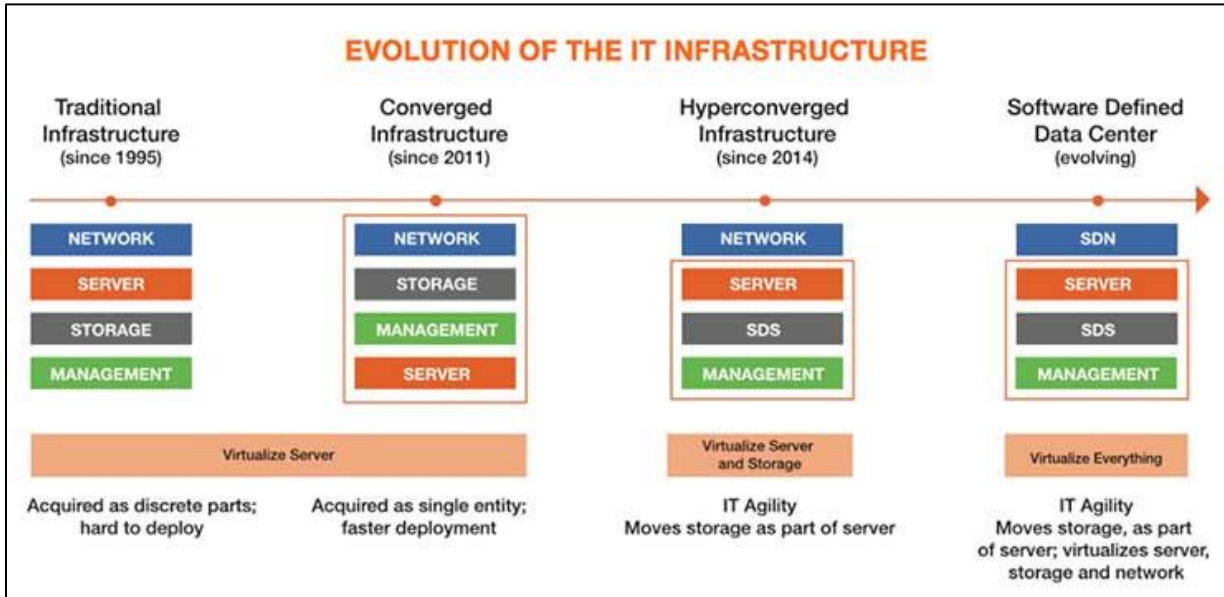
Converged and Hyper-converged Infrastructure Recommendations

1. The Commonwealth is interested in newer technical solutions including converged infrastructure (CI) and hyper-converged infrastructure (HCI). CI and HCI represent various methods that positively increase infrastructure efficiencies, and should be considered by agencies as suitable solutions.
 - a. For CI and HCI offerings, VITA recommends:
 - i. CI and HCI that is:
 1. hardware and hypervisor-agnostic.
 2. support DRAM and flash devices from any vendor.
 3. have a disk infrastructure that is direct, and legacy SAN-attached, to fully realize expected ROI from one's SAN.
 4. can virtualize all storage capacity allowing management of capacity allocations and special storage services at multiple sites, and on heterogeneous storage gear from a single software interface.
 - ii. Use of CI where it supports relevant business requirements and use cases, because it provides the most flexibility to respond to the unpredictable challenges in the future while still providing convergence advantages.
 - iii. Use of CI/HCI for larger applications such as Oracle, Microsoft Exchange, SAP, etc.
 1. When choosing to implement a converged storage solution (CI/HCI), be sure to review any new DAS utilization.
 - iv. Use of HCI hyper-converged architectures in agencies where:
 1. there is no dedicated IT staff.
 2. technical expertise does not support traditional IT infrastructure support.
 3. virtual desktop infrastructure (VDI) deployments are being considered



Enterprise Architecture Converged and Hyper-converged Infrastructure

- v. Using HCI where it supports relevant business requirements and use cases, because it simplifies the procurement process by providing a single SKU product.





Converged Infrastructure
and
Hyper-converged Infrastructure
Research



Converged Infrastructure



VITA Server, Storage, and Data Center Services RFP. ¹

- 5.2: Server, Storage, Network, and Data Center Services Evolution
 - R490: The Commonwealth is interested in newer technical Services solutions which may include technical and/or physical changes (e.g. hyper-converged, converged, Software Defined Network (SDN), solid-state storage, data center services).

VITA Critical IT Infrastructure Changes. ²

- Converged infrastructure (CI).
 - Brings the four core aspects of a data center into building block approach of a single chassis tied together in a centralized management platform.
 - Compute, Storage, Networking, and Server.

¹ VITA Exhibit 2.1, Description of Services, Server, Storage and Data Center Services, RFP 2017-04: Server, Storage and Data Center by Supply Chain Management Division in 2017.

² VITA - Critical IT Infrastructure Changes by Todd D. Kissam (VITA Chief Enterprise Architect) on August 10, 2017.



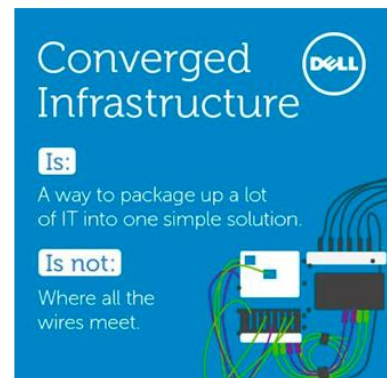
Enterprise Architecture Converged and Hyper-converged Infrastructure

- Eliminates former technology silos.
 - Can, but not always, comprise systems from different vendors.
 - Tend to be designed to scale to a specific size.
 - Expansion is no small task.
- Benefits of CI.
 - CI = ready-made.
 - Integrate, pre-test, and pre-configure systems prior to shipping to customers.
 - Customers unpack box, plug it into network and power, and system is ready to use.
 - CI chosen for deployment and management ease instead of the benefits of an open, interoperable system with choice of components.
 - Simplicity overcomes choice.



Converged vs. Hyper-converged (continued)

- Benefits of CI continued
 - From a scalability perspective, converged systems are more suited to larger applications
 - Oracle
 - Microsoft Exchange
 - SAP, etc.





Building an IT infrastructure [Converged, Hyper-converged and Public Cloud]. ³

- The major components of an IT infrastructure include:
 - Computer hardware.
 - Operating systems.
 - Enterprise and other applications.
 - Data management and storage.
 - Networking platforms.
 - Internet platforms.
- What is Converged Infrastructure
 - Converged infrastructure helps combine all the different disparate elements that power IT including management software, servers, applications, and virtualization.
 - Overall, CI helps lower compatibility issues by reducing costs for power, floor space, cooling, and cabling.
- While converged infrastructures may be installed on bare metal servers, in most cases all components are virtualized.
 - Creates a cost effective and highly automated infrastructure, which responds quickly to changing requirements without having to reorganize physical components or get new ones.
- There are disadvantages to converged infrastructure, such as: 1) The ratio of resources, including CPU, network, and storage are predefined and not as flexible as some users may want; 2) Products cannot always be used for existing legacy systems or prevailing infrastructure.
 - Hyper-convergence infrastructure takes convergence infrastructure to a completely new level by adding the benefits of convergence together and going beyond storage and servers.



Measuring the Business Value of Converged Systems. ⁴

- Three key strategies for getting the most from converged systems:
 - Datacenter transformation.
 - Application-specific acceleration.
 - New service creation.

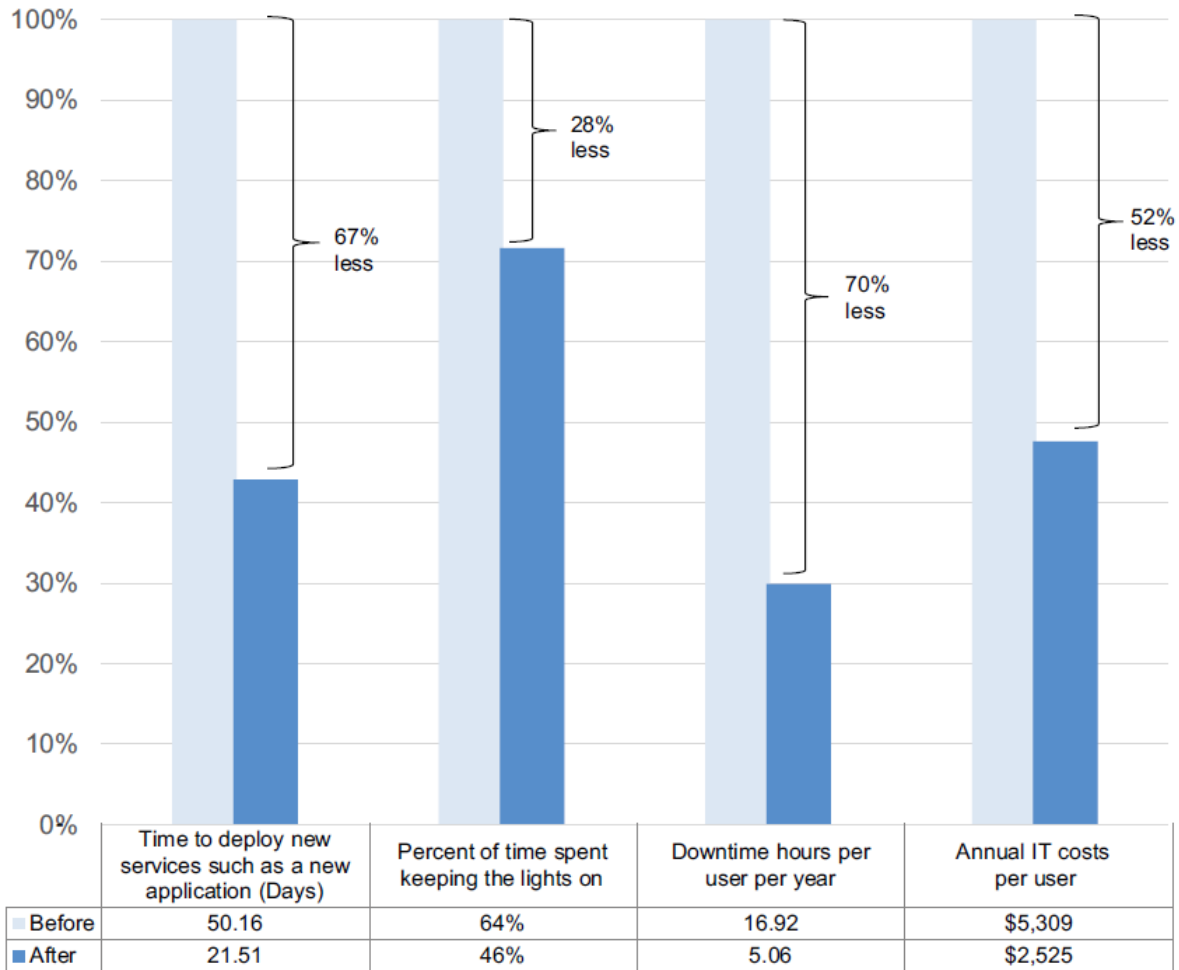
³ Building an IT infrastructure [Converged, Hyper-converged, and Public Cloud] by Simform in August 22, 2017. Downloaded from the internet in December 2018.

⁴ Measuring the Business Value of Converged Systems by IDC and sponsored by HPE in December 2014. Downloaded from the internet in December 2018.



The Positive Effects of Increased Convergence — Key Performance Before and After Increasing Convergence

Q. For each of the following questions, please indicate both the current values and the values before the organization made the transition to significantly increased convergence (measures: deployment, downtime, etc.).



Note: Approximately 75% of the 20 respondents indicated they had been making the transition to significantly increased convergence. These findings come from that 75% subset.

- Of organizations in the survey that had been transitioning to converged infrastructures, improvements in each of the following metrics were realized:
 - Mean time to deploy new services such as a new application.



Enterprise Architecture Converged and Hyper-converged Infrastructure

- Percentage of staff time spent “Keeping the lights on”.
- Downtime hours per user per year.
- Annual IT costs per year.

Converged or hyperconverged?

These two terms are often used interchangeably, but there are significant differences.

Converged infrastructure refers to an optimized, tightly integrated collection of IT components offered by one or more technology vendors that includes compute, storage, and networking resources. It simplifies management, offers quick deployment, and scales with ease.

Hyperconverged infrastructure (HCI) is based on a hypervisor-centric architecture and includes compute, networking, virtualization, and storage in a single box from a single vendor. This can be attractive from a simplicity standpoint, but there are drawbacks. For example, all of the hardware elements are tightly coupled and cannot be scaled independently from one another. Therefore, when you need to add more of a single element, such as storage, you cannot simply add storage capacity by itself. You must add an entire system building block, including compute, memory, and networking resources, in addition to the desired storage capacity.

For systems that need to scale while delivering consistent and predictable high performance, converged infrastructure is the answer. It provides the ability to more rapidly and flexibly provision infrastructure and services than either traditional or hyperconverged systems. Here are the top three reasons you should consider making converged infrastructure the cornerstone of your infrastructure strategy.

REASONS TO MAKE THE CHANGE

How do you know for sure that your business is ready for converged infrastructure?
Here are some signs for which to watch:



1. Your IT is unwieldy and unable to adjust to new requests from lines of business.



2. You are experiencing lengthy deployment times that cause projects to get stuck in limbo.



3. Too much staff is utilized and too much budget is spent on IT system maintenance.



Converged Infrastructure Benefits and Selection Criteria. ⁵

- The data center has a significant influence on a company's success.
 - "Converged infrastructure" is a technology that can be used as a basis for a high-performance, efficient data center.
- A converged infrastructure combines data center components into a centrally managed system.
 - Such systems are closely integrated components in preconfigured appliances or reference architectures (blueprints) for the set-up and centralized management of a (scalable) infrastructure.
 - Consist of network, storage, and compute resources equipped with orchestration and life cycle management software.
- Converged systems feature a lower degree of integration, ensuring more freedom regarding the structure, and later extension of the system, specifically when it comes to individual (storage and compute) components, where granular extension is possible.
 - A major advantage for user organizations that must ensure options to respond flexibly to unpredictable challenges of the future.
 - Considering the long-term character of data center investments, this decision-making factor should not be underestimated.
- Converged systems can address users' need for fast and cost-efficient deployment.
 - Converged systems, with their tightly integrated and preconfigured components, and validated architecture blueprints, make it easier to build up a data center.
 - Converged system providers take over a large part of tasks, reducing users' workload accordingly.
 - Secure solutions.
 - Efficient support.



⁵ Converged Infrastructure Benefits and Selection Criteria by Information Services Group (ISG) in Frankfurt, Germany in April 2018. Obtained from the internet in December 2018.

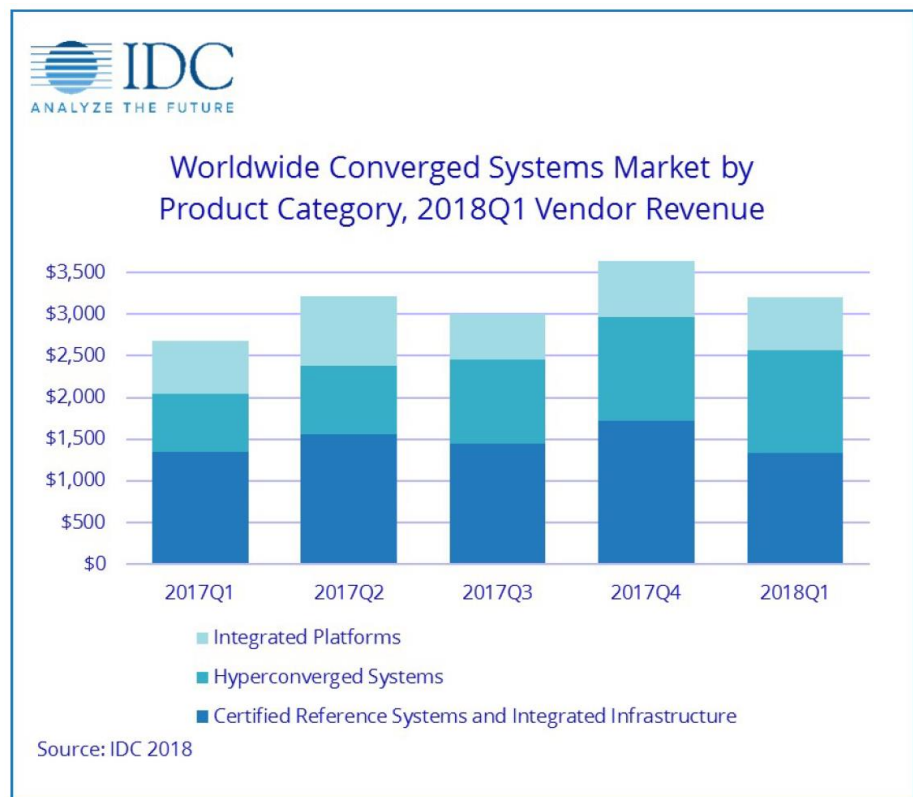


Enterprise Architecture Converged and Hyper-converged Infrastructure

- Converged infrastructure solutions provide many benefits, including fast implementation, easy management, flexibility, high performance and efficient support.

Worldwide Quarterly Converged Systems Tracker. ⁶

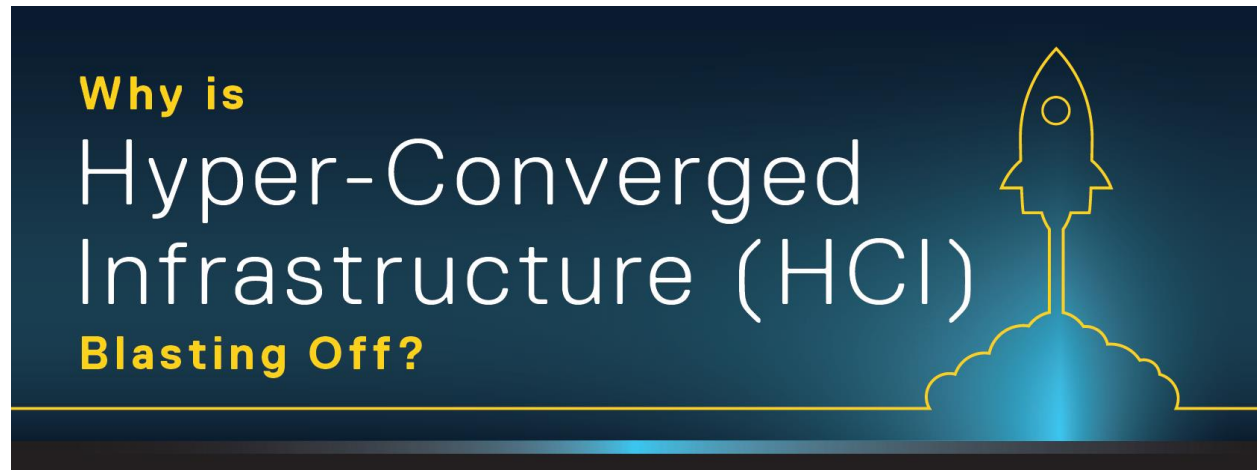
- Organizations around the world are increasing their investments on datacenter technologies that eliminate inefficient silos and support business-centric decisions rather than infrastructure-centric decisions.
 - This is driving increased spending on converged systems that can safely reduce the complexity of datacenter infrastructure and allow IT teams to focus on high-value business projects.
- IDC defines converged systems as pre-integrated, vendor-certified systems containing server hardware, disk storage systems, networking equipment, and basic element/systems management software.



⁶ Worldwide Quarterly Converged Systems Tracker by IDC, a subsidiary of IDG in March-2018. Downloaded from the internet in December 2018.



Hyper-converged Infrastructure



VITA Server, Storage, and Data Center Services RFP. ⁷

- 5.0: Server/Storage/Network Documentation, Analysis, and Evolution.
 - R446: VITA and its Customers provide essential services to the citizens of Virginia. Many of these essential services depend on a stable computing environment providing Server, Storage, and Directory Services. VITA and its Customer Agencies have taken a very conservative approach to technology over the last decade and are now interested in exploring the performance and efficiency improvements that are available via new and emerging technologies such as Software Defined Networks and hyper-converged environments.
- 5.2: Server, Storage, Network, and Data Center Services Evolution.
 - R490: The Commonwealth is interested in newer technical Services solutions which may include technical and/or physical changes (e.g. hyper-converged, converged, Software Defined Network (SDN), solid-state storage, data center services).

⁷ VITA Exhibit 2.1, Description of Services, Server, Storage and Data Center Services, RFP 2017-04: Server, Storage and Data Center by Supply Chain Management Division in 2017.



VITA Server & Storage Summary and Recommendations. ⁸


- Servers (General): Recommended Tactical Direction
 - Converged or hyper-converged technology means server supplier provides data center networks.
- Storage: Future Trends
 - Hyper-converged technology can deliver SAN, NAS, or DAS in any combination.
 - Same hardware (high-performance SSD drives (e.g. NVMe) utilizing peripheral component interconnect express (PCIe) technology.
- Storage: Recommended Tactical Direction
 - Prepare for hyper-converged solutions.
 - Initially, new provider may use converged technology to support service transition.
 - Dell EMC VCE vBlock still expensive, but more flexible than current VITA SAN.
 - If converged technology, review any new DAS utilization.

Operational Efficiency

HCI consolidates multiple administration functions into a simple, unified management framework



Empower IT with simplified management



Scale up and out with ease and granularity



Avoid complex maintenance and integration challenges

Environment with Traditional Enterprise SAN



»

Hyperconverged Infrastructure



“

We managed to significantly reduce overall costs and server provisioning time, enabling our lecturers to adopt new innovations in educational technology.

CATHOLIC UNIVERSITY OF INDONESIA
ATMA JAYA

”

Up to

59%

Less Time for Storage Tasks*

* Source: IDC study of vSAN users

One tool. One team.

⁸ VITA Server & Storage Summary and Recommendations presentation by Todd D. Kissam (VITA Chief Enterprise Architect) in July 2017.



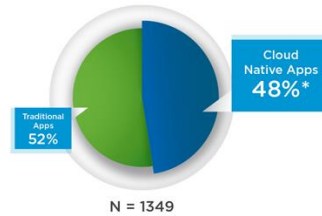
Enterprise Architecture Converged and Hyper-converged Infrastructure

Flexible, Strategic Platform

Hyperconverged Infrastructure provides a flexible strategic platform for next generation applications

“
Hyperconvergence remains one of the hottest trends in data center infrastructure.
- **Gartner.**
”

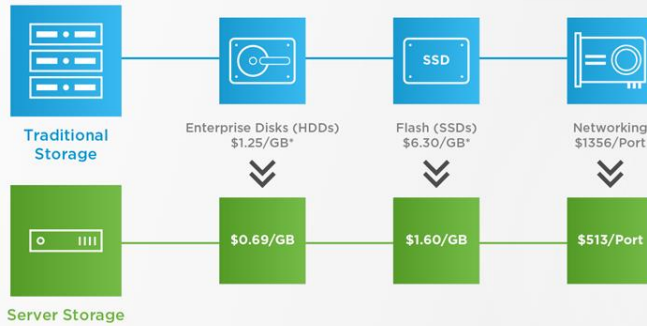
48% of new on-premises apps use "cloud native" architectures



* Source: VMware Core Metrics Survey 2017



Server-Side Economics Reduces CapEx

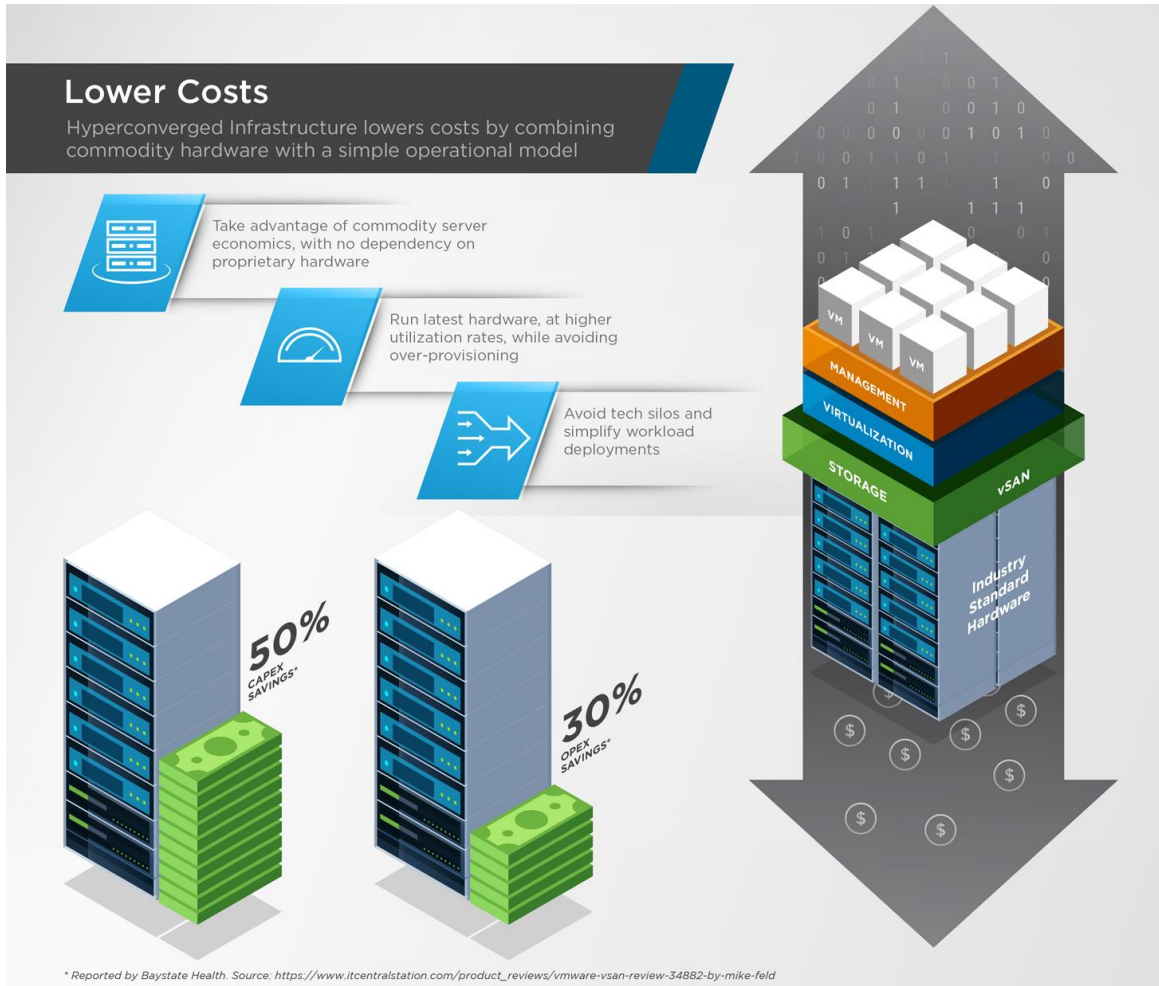


* Source: \$/GB refers to disk prices raw GB only and is based on publicly available list prices as of Nov 2016

“
We were able to introduce commodity flash drives into a hybrid cluster at 90% less cost than using proprietary flash drives from our previous SAN vendor.
- **CINgroup**
”



Enterprise Architecture Converged and Hyper-converged Infrastructure



VITA Critical IT Infrastructure Changes. ⁹

- HCI technology is software defined.
 - Technology is integrated in such a way that it cannot be broken out into its separate components.

⁹ VITA - Critical IT Infrastructure Changes by Todd D. Kissam (VITA Chief Enterprise Architect) on August 10, 2017.

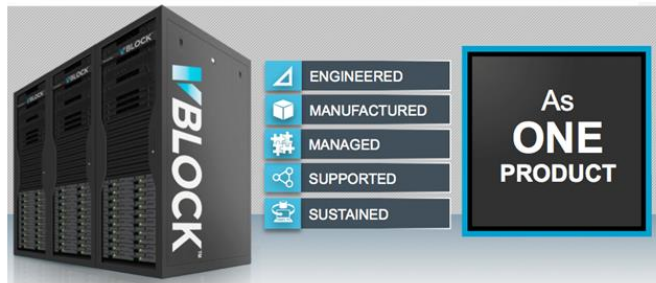


Enterprise Architecture Converged and Hyper-converged Infrastructure



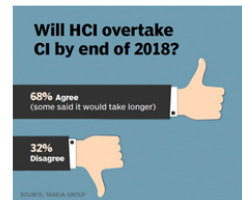
Converged vs. Hyper-converged (continued)

- Hyper-converged infrastructure (HCI)
 - Adds **tighter integration** of CI through the use of software
- Only offered in a single appliance from a single vendor.



Converged vs. Hyper-converged (continued)

- CI and HCI Benefits
 - Both converged options look to simplify operations
 - Enable creation of on-premise clouds with elastic workloads and resource pooling
 - Help reduce VDI deployment complexity
 - Great benefits when virtualizing desktops
 - VDI = Virtual Desktop Infrastructure









Enterprise Architecture Converged and Hyper-converged Infrastructure

- Perhaps the most impactful of both converged and hyper-converged benefits are the ability to provision, test, and deploy IT dramatically faster.
 - Major reduction of time and resources needed to manage and maintain the infrastructure once operational.
 - Not merely benefits claimed by vendors; they are increasingly proven and documented.
- HCI takes the CI integration process a step further by adding the features of storage and server virtualization together in a single hardware offering.
- HCI can be deployed on as little as four servers.
- HCI is particularly valuable for VDI because it can scale up quickly without a ton of added expense.
 - Often comes with a lot of flash, which is great for virtual desktop performance.
 - Reduces complexity and costs.
- HCI technology is software defined.
 - It is integrated in such a way that it cannot be broken out into its separate components.



Converged vs. Hyper-converged (continued)

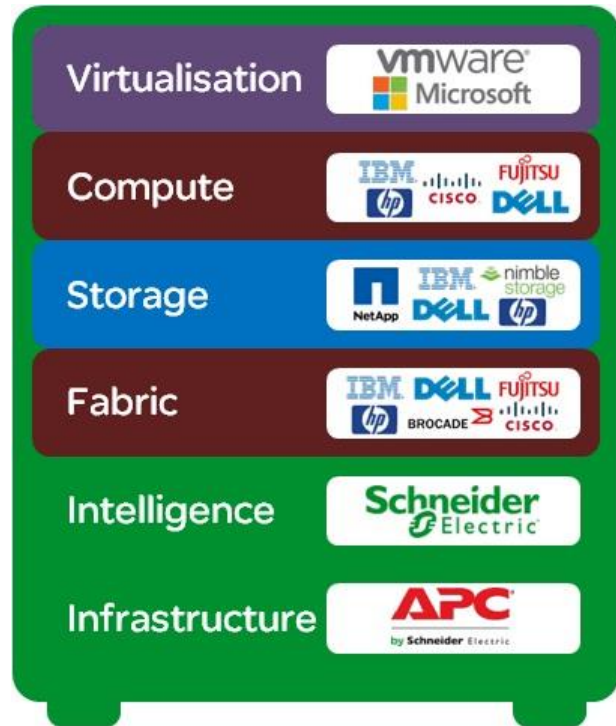
- Benefits of HCI continued
 - HCI offerings are aimed at reducing the administrative or operational burden when compared to traditional or converged systems – simpler

 Radically Simple	 Highest Performance	 Lowest Cost	 Any App, Any Scale
1 Integrated software stack deployed on preferred hardware	>100K IOPS per node with sub-millisecond latency	\$1/GB As low as \$1 per usable GB of all-flash	>6M IOPS per cluster for any business critical application

VMware Hyper-converged Software



Enterprise Architecture Converged and Hyper-converged Infrastructure



- HCI means:
 - Server/storage vendor will also supply network within data centers
 - Lower cost of infrastructure
 - Agencies consume platforms as opposed to infrastructure, so no change in services other than quicker provisioning

Hyper-converged Infrastructure Magic Quadrant. ¹⁰

- Hyper-converged infrastructure (HCI) is a category of scale-out software-integrated infrastructure that applies a modular approach to compute, network, and storage on standard hardware, leveraging distributed, horizontal building blocks under unified management.
 - HCI vendors either build their own appliances using common, off-the-shelf infrastructure (hardware, virtualization, operating

¹⁰ Hyper-converged Infrastructure Magic Quadrant by Gartner - Nov-27-2018.

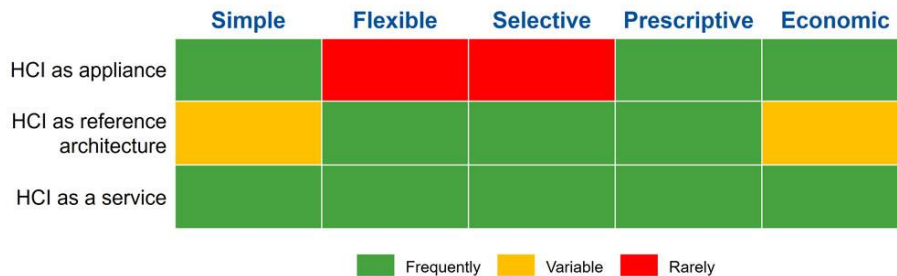


Enterprise Architecture Converged and Hyper-converged Infrastructure

system), or they engage with system vendors that package the HCI vendor's software stack as an appliance.

- Vendor approaches to HCI include:
 - A storage virtualization and data management perspective
 - Partnering for all other components of the HCI stack (hypervisor, network virtualization, management).
 - A server virtualization perspective
 - Add storage virtualization and data management services later.
 - A hardware appliance perspective as the natural evolution of a server vendor's installed base of x86 servers.
 - Either acquired an existing HCI or hyperconverged integrated system (HCIS) company, or partnered with multiple HCI companies to deliver appliances or reference architectures.
 - A full-stack perspective.
 - A startup is willing to compete head-to-head with leading hypervisor suppliers by initially focusing on a single niche.

Why HCI-aaS Is a High Priority If Cloud Is in Your Future



Only HCI-aaS readily accommodates the 5 Gartner Key Determinants*

Source: "Five Keys to Creating an Effective Hyperconvergence Strategy" (G00292684)
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- A larger software offering with public cloud is an integral part of the strategy
 - This applies to Microsoft who is also a public cloud vendor. For Microsoft, the hypervisor, storage, and data management services are a no-additional-charge feature. Whereas, for most HCI vendors, the public cloud is an



Enterprise Architecture Converged and Hyper-converged Infrastructure

extension of the strategy making it potentially a strategic threat to Microsoft.

Magic Quadrant for Hyperconverged Infrastructure





Enterprise Architecture Converged and Hyper-converged Infrastructure

Hyperconvergence 101. ¹¹

🔍 **Examining infrastructure**

Here's a breakdown of different infrastructure types:

<div style="border: 2px dashed blue; padding: 10px; font-size: 48px; font-weight: bold; color: blue;">T</div> <p>Traditional IT infrastructure: Siloed system with a number of operations and groups</p>	<div style="border: 2px dashed blue; padding: 10px; font-size: 48px; font-weight: bold; color: blue;">C</div> <p>Converged infrastructure: Pre-engineered solution where separate components work together</p>	<div style="border: 2px dashed blue; padding: 10px; font-size: 48px; font-weight: bold; color: blue;">H</div> <p>Hyperconverged infrastructure: Software-defined solution that helps IT scale by adding more modules (not more drives, memory or CPUs)</p>
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Where Technology Means More®

💡 **HCI: A brand new school of thought**

Adopting a hyperconverged infrastructure can:

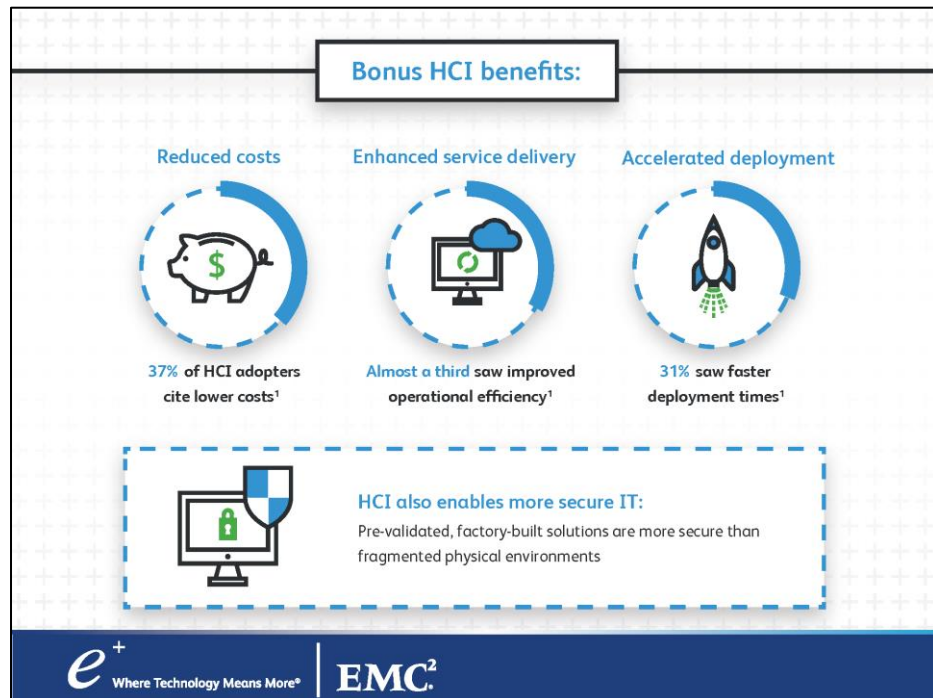
<p>Simplify IT infrastructure management</p>	<p>Enable cloud computing</p>	<p>Optimize workloads</p>	<p>Improve performance</p>
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Where Technology Means More®

¹¹ Hyperconvergence 101: A crash course in redefining your infrastructure by EMC / ePlus in 2016. Downloaded in December 2018.



Enterprise Architecture Converged and Hyper-converged Infrastructure



Hyper Converged Infrastructure vs Converged Infrastructure. ¹²

- Hyper converged infrastructure is often named HCI.
 - Introduced in 2012, HCI describes a fully software-defined IT infrastructure that virtualizes all the elements of conventional hardware-defined systems.
 - Generally, hyper converged infrastructure is at least composed of virtualized computing (a Hypervisor), a virtualized SAN (software-defined storage) and virtualized networking (Software-defined networking).
 - It can be utilized as a way to pool together resources to maximize the interoperability of on-premises infrastructure.
- Hyper Converged vs Converged Infrastructure Components

¹² Hyper Converged Infrastructure vs Converged Infrastructure by Network Solutions' Amelia Liu on October 27, 2017. Obtained via the internet in December 2018.



- Converged infrastructure defines compute, storage, networking and server virtualization—which are the four core components in a data center—as one dense building block.
- Hyper-converged infrastructure was born from converged infrastructure and the idea of the software-defined data center (SDDC).
 - Besides the data center’s four core components, hyper-converged infrastructure integrates more components such as backup software, snapshot capabilities, data deduplication, inline compression, WAN optimization and so on.

The Business Value of Modernizing Infrastructure with Hyper-Converged Systems. ¹³

- Business value of HCI highlights:
 - Five (5) year ROI – 619%.
 - Six (6) months to payback.
 - Lower cost of operations – 59%.
 - Faster to deploy – 73%.
 - Less staff time to deploy storage – 81%.
 - Less unplanned downtime – 98%.
 - Improved application performance – 42%.

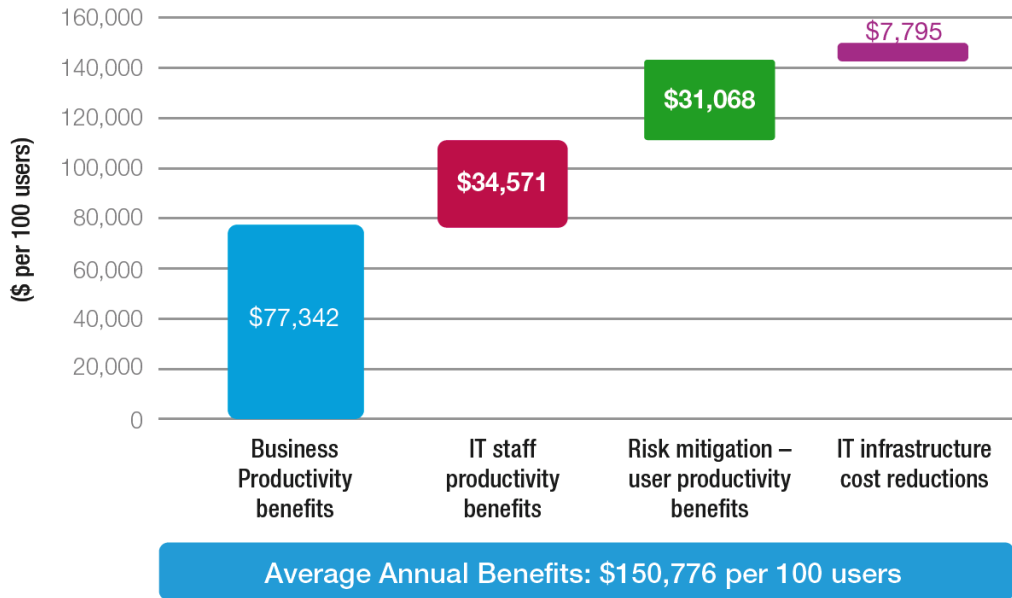


¹³The Business Value of Modernizing Infrastructure with Hyper-Converged Systems by International Data Corporation (IDC) in October 2017. Obtained from the internet in December 2018.



Enterprise Architecture Converged and Hyper-converged Infrastructure

FIGURE 1 Average Annual Benefits per 100 Users



Source: IDC, 2017

TABLE 3 Business Productivity Benefits

	Per Organization	Per 100 Users
Revenue impact due to better addressing business opportunities		
Additional revenue per year	\$421,100	\$29,024
Recognized revenue per year — IDC model*	\$63,200	\$4,354
Revenue impact due to unplanned downtime		
Additional revenue per year	\$1.2 million	\$85,785
Recognized revenue per year — IDC model*	\$186,700	\$12,868
User productivity impact		
Number of users impacted	252	17
Equivalent FTE gain	9.9	0.7
Other operational cost reductions per year	\$363,000	\$25,021

* The IDC model assumes a 15% operating margin for all additional revenue.

Source: IDC, 2017



TABLE 5 ROI Analysis

	Five-Year Average per Organization	Five-Year Average per 100 Users
Benefit (discounted)	\$7.82 million	\$539,059
Investment (discounted)	\$1.09 million	\$74,951
Net present value (NPV)	\$6.73 million	\$464,108
Return on investment (ROI)	619%	619%
Payback period	6 months	6 months
Discount rate	12%	12%

Source: IDC, 2017

Dell State of IT Trends 2016 Survey Results. ¹⁴

- More than 8 in 10 of ITDMs and BDMs agree that integrating hyper-converged solutions is the first step in achieving a software-defined data center (SDDC).
 - BDM = Business Decision Makers.
 - ITDM = IT Decision Makers.
 - An SDDC is a top enabler to digital transformation.
 - ITDMs more likely to mention hybrid/multi-cloud as a top enabler.

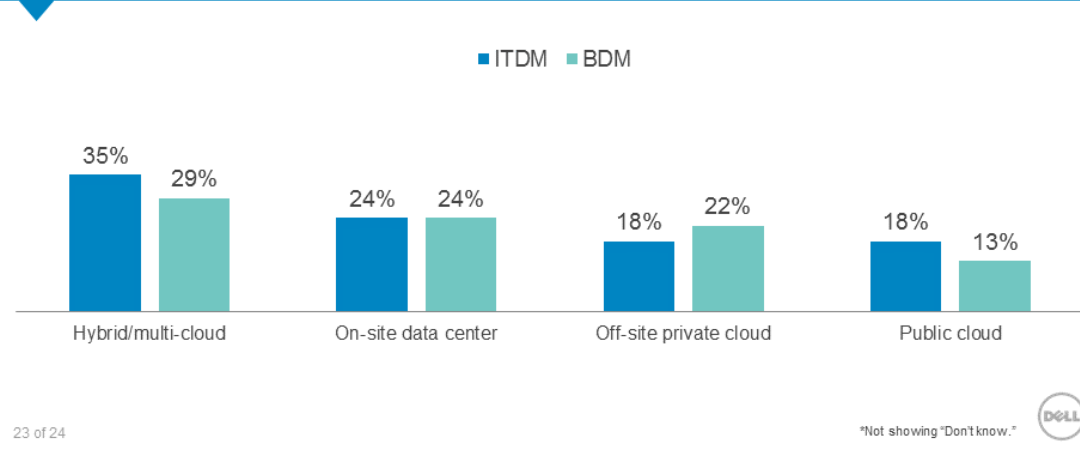
¹⁴ Dell State of IT Trends 2016 Survey Results conducted by PSB in July 2016. Obtained from the internet in December 2018.



Enterprise Architecture Converged and Hyper-converged Infrastructure

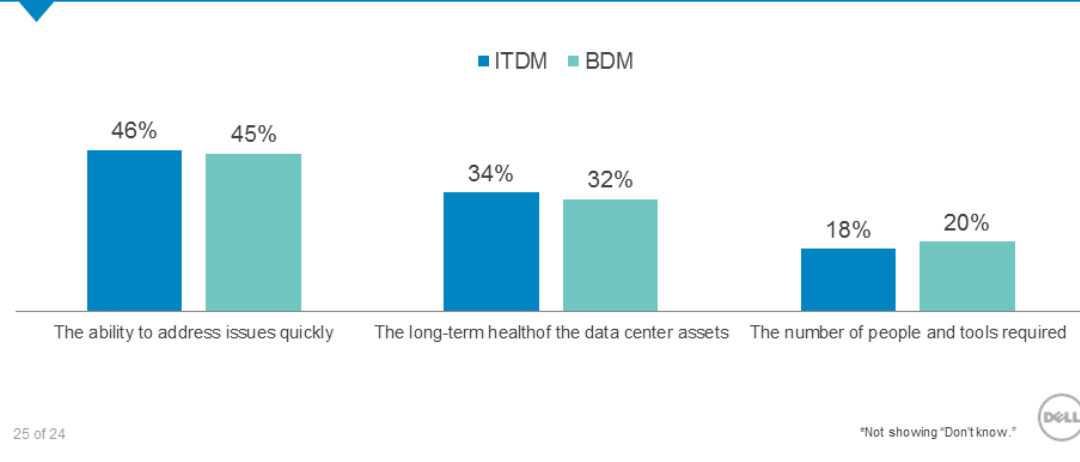
Software-defined data centers to be hybrid cloud-based in the future

Where do you expect software for software-defined data centers to reside in the future?



Addressing issues quickly is top concern when managing the data center

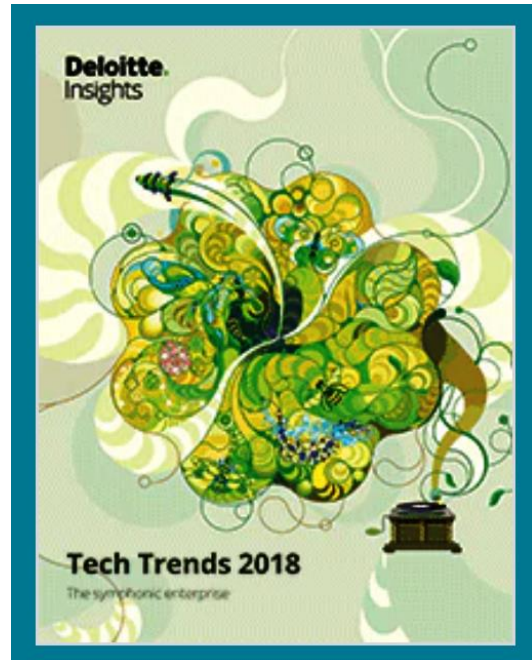
What concerns you most when it comes to managing the data center?





Tech Trends 2018: The Symphonic Enterprise. ¹⁵

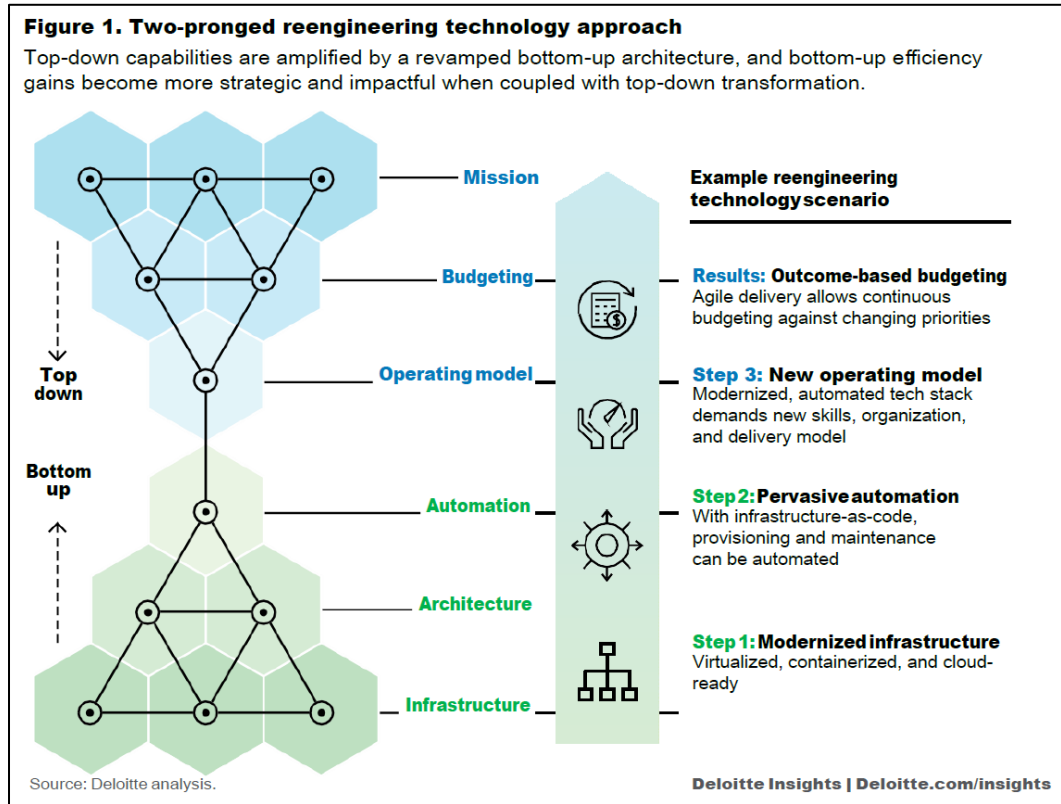
- Over the next 18 to 24 months, we will likely see CIOs begin reengineering not only their IT shops but, more broadly, their approaches to technology. Expect to see many CIOs deploy a two-pronged strategy.
 - From the bottom up, they can focus on creating an IT environment in which infrastructure is scalable and dynamic and architecture is open and extendable.
 - From the top down, CIOs and their teams have an opportunity to transform how the shop budgets, organizes, staffs, and delivers services.
- Companies want to use software-defined everything, to automate platforms, and to extrapolate infrastructure to code.
 - It is not atypical these days for a company to have thousands of developers and thousands of applications, but only a handful of infrastructure or operations resources.
 - Of course, they still need physical infrastructure, but they are automating the management, optimization, and updating of that infrastructure with software.
 - Our customers want to put their money into changing things rather than simply running them; they want to reengineer their IT stacks and organizations to be optimized for speed and results.
 - In doing so, IT is being seen as BT – “business technology,” with priorities directly aligned to customer impact and go-to-market outcomes.



¹⁵ Tech Trends 2018: The Symphonic Enterprise – Deloitte Insights; Deloitte Consulting LLP's Technology Consulting Practice. Obtained via the internet in December 2018.



Enterprise Architecture Converged and Hyper-converged Infrastructure



Hyperconvergence Today: A Technical Market Guide. 16

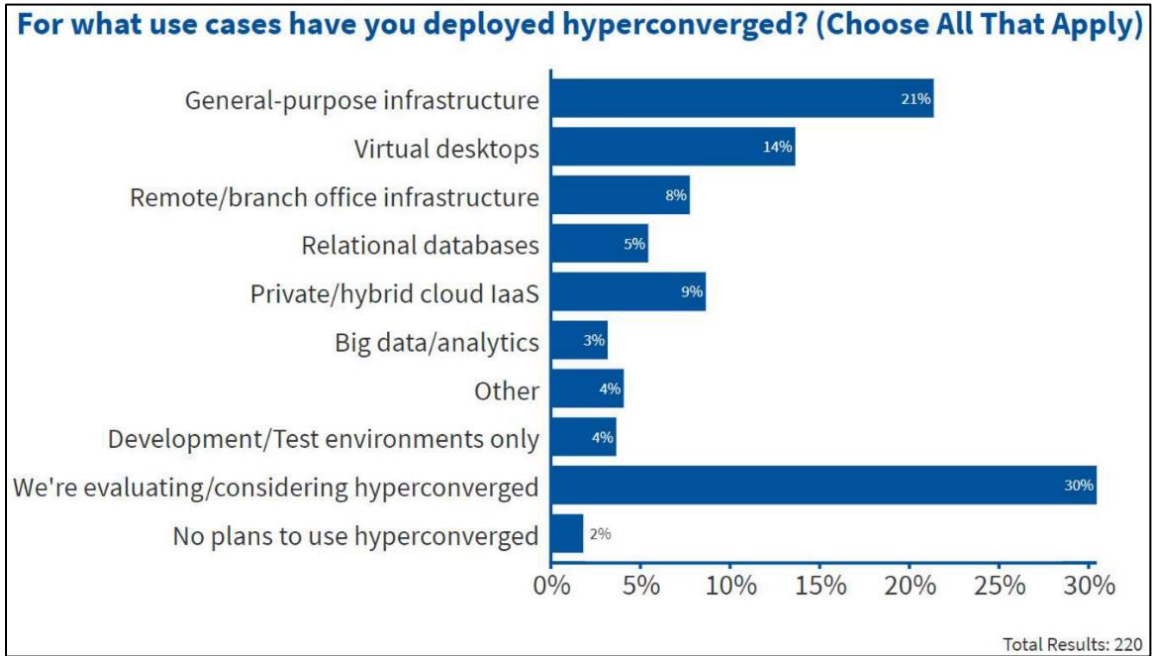
- Hyperconverged is increasingly the default option for data center infrastructure buyers.
- It is a great building block for private/hybrid cloud.
- Makes building and maintaining infrastructure easier.
- Not suitable for every workload.

Always includes	May also include
<ul style="list-style-type: none"> ▪ CPU, RAM, local storage ▪ Software-defined compute ▪ Software-defined storage ▪ Data services ▪ Single control plane 	<ul style="list-style-type: none"> ▪ Physical network switching ▪ Software-defined networking ▪ Cloud management platform ▪ Connectivity to public cloud IaaS ▪ Control of storage arrays

¹⁶ Hyperconvergence Today: A Technical Market Guide by Gartner - August 2018. Obtained September 2018.



Enterprise Architecture Converged and Hyper-converged Infrastructure

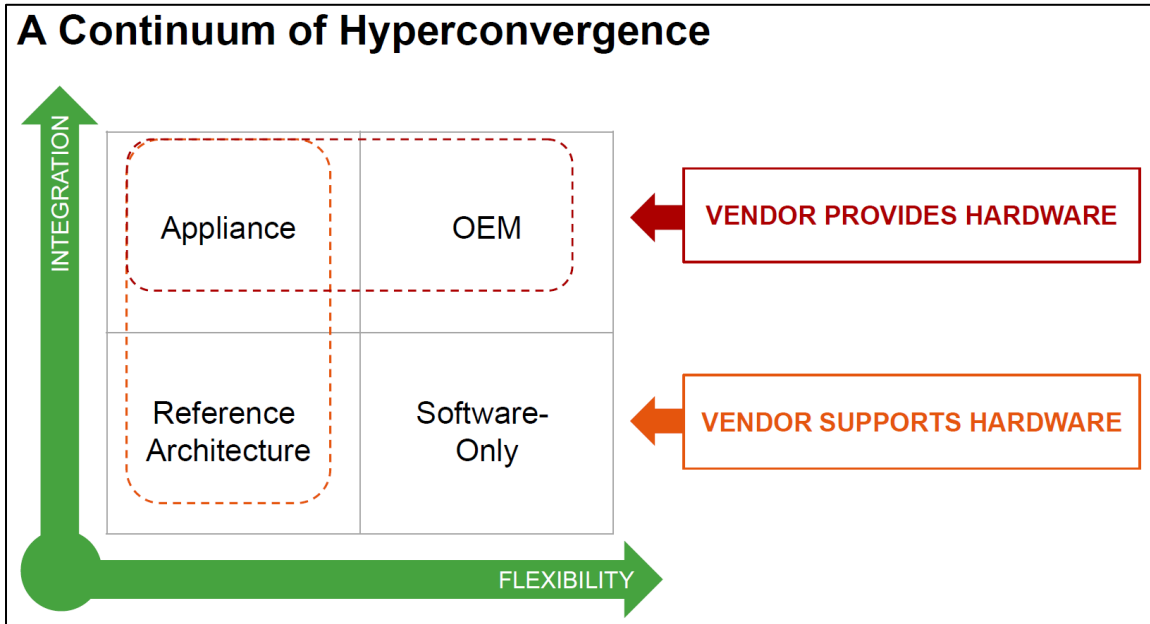


The SDDC Battlefield

	VMware	Microsoft	Red Hat	Nutanix
Cloud Management	vRealize	Operations Management Suite	CloudForms	Calm
Hypervisor	ESXi	Hyper-V	RHV-H	AHV
Storage	vSAN	Storage Spaces Direct	Gluster	Acropolis Data Fabric
Networking	NSX	Windows Server 2016 SDN	OpenStack Neutron + OVN	Acropolis Networking Services



Enterprise Architecture Converged and Hyper-converged Infrastructure



Deployment Model Pros and Cons

<p>Appliance</p>	<ul style="list-style-type: none"> Fastest time to value Fully qualified hardware and software stack One vendor supports all problems 	<ul style="list-style-type: none"> Both SW and HW lock-in May be (ODM)/whitebox HW Vendor may be an immature startup
<p>OEM</p>	<ul style="list-style-type: none"> Runs on preferred hardware Fully qualified hardware and software stack One support contact 	<ul style="list-style-type: none"> Both SW and HW lock-in Vendor provides only first-call SW support with escalation to SW vendor
<p>Reference Architecture</p>	<ul style="list-style-type: none"> Runs on preferred hardware Fully qualified hardware and software stack Less hardware lock-in 	<ul style="list-style-type: none"> Probably assembled by a VAR Longer time to value, less integration Support models vary
<p>Software-Only</p>	<ul style="list-style-type: none"> Most flexibility No hardware lock-in More hardware options (cheap, custom, etc.) 	<ul style="list-style-type: none"> Customer must assemble system Vendor cannot qualify hardware No common support for HW and SW



Enterprise Architecture Converged and Hyper-converged Infrastructure

Available Deployment Models

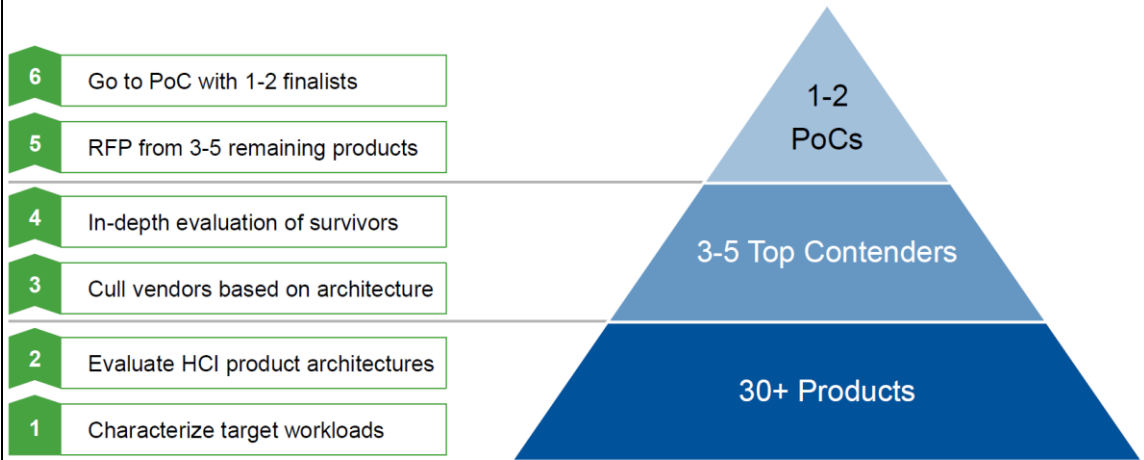
VENDOR	APPLIANCE	OEM	REF. ARCH.	SW ONLY
Cisco	●	●	●	○
HPE SimpliVity	●	○	○	○
HyperGrid	●	○	●	●
Nutanix	●	○	●	◐*
Pivot3	●	○	●	●
Scale Computing	●	○	○	○
Stratoscale	○	○	●	●
VMware/Dell	●	●	●	●

* Not Supported for Production

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How to Select a Hyperconverged Product



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- For most major vendors, public cloud IaaS is included in the box.
- Know the product’s roadmap that you’re thinking of purchasing because today’s hyper-converged products will change substantially



over a three (3) to five (5) year duty cycle, including many vendors that will not be in the business in five years.

Building an IT infrastructure [Converged, Hyper-converged and Public Cloud]. ¹⁷

- Enterprises have embraced the cloud (pay as you go model) in the last decade, but the move data from legacy systems was a struggle and that is how hyper-converged and converged architecture appeared.
- The biggest difference between converged and hyper-converged infrastructure is that while CI is hardware-based, HCI is software-based.
 - HCI is designed to cut 4 to 60 percent of costs from legacy infrastructure by removing separate storage networking and proprietary storage hardware.
- Enterprises are using HCI for to: 1) Deploy new tier-1 applications; 2) Provide better backup and disaster recovery; 3) Enable smoother transitions; 4) Manage resources remotely
- The Benefits of Hyper-Converged Infrastructure include:
 - Scalability.
 - Better Mobility and Data Availability.
 - Automation and Agility.



Choosing the Right Container Infrastructure for your Organization. ¹⁸

- Container adoption is accelerating rapidly with Gartner predicting more than 50% of new workloads will be deployed into containers in 2018.
- Docker expects 30x growth of containerized apps in two years.
- Bare metal is the gold standard for production containers.
 - Why?

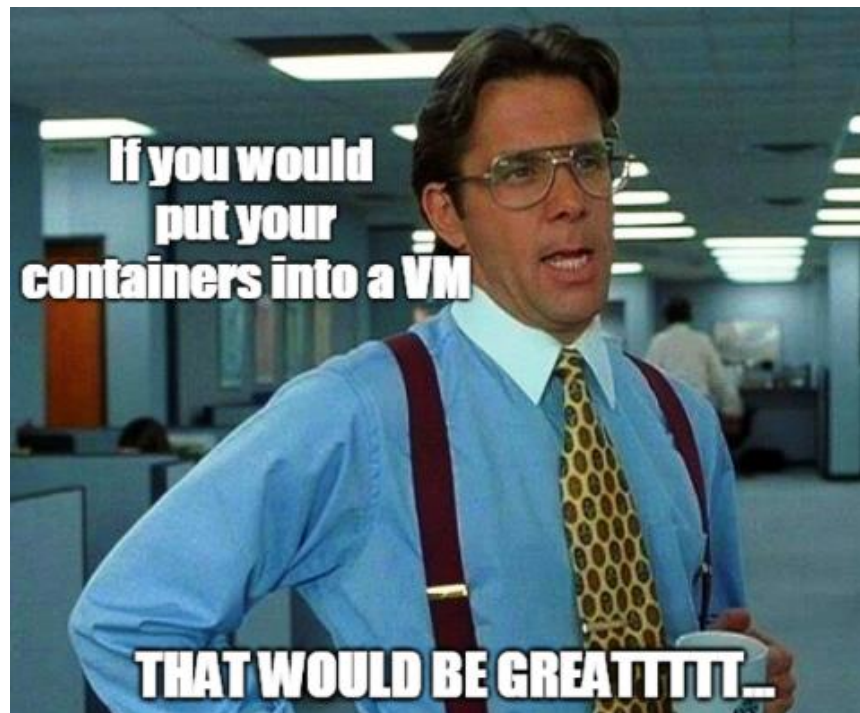
¹⁷ Building an IT infrastructure [Converged, Hyper-converged, and Public Cloud] by Simform in August 22, 2017. Downloaded from the internet in December 2018.

¹⁸ Choosing the Right Container Infrastructure for your Organization by Diamanti on April 12, 2018. Obtained from the internet in December 2018.



Enterprise Architecture Converged and Hyper-converged Infrastructure

- Bare-metal containers provide optimal performance, allowing applications to access hardware without the need for pass-through, or hardware emulation.
- Bare-metal delivers many of the perceived advantages of virtualization including application portability and isolation.
 - Running containers inside virtual machines is like doing virtualization on top of virtualization – totally unnecessary.



- Interestingly, existing IT infrastructure optimized over a period of many years for virtualized business applications may not efficiently support containers.
 - As you navigate the transition from virtualization, you'll need infrastructure that addresses the unique needs of a container environment.



FEBRUARY 22ND, 2017 by Adam Armstrong

Diamanti Ships First Bare-Metal HCI Container Platform & Raises \$18M

Today Diamanti made two announcements. First they are announcing the general availability of their new bare-metal hyper-converged infrastructure container platform, Diamanti D10. According to Diamanti, the D10 will allow companies to deploy Docker containers in seconds with guaranteed service levels at a fraction of the cost of traditional data center infrastructure. Diamanti is also announcing that it has raised an additional \$18 million in series B funding.



The new Diamanti D10 is the first platform that brings the efficiency of bare-metal containers to hyper-converged architecture. Diamanti claims the D10 can eliminate the I/O bottlenecks as well as the network and storage issues one would encounter in traditional infrastructure.

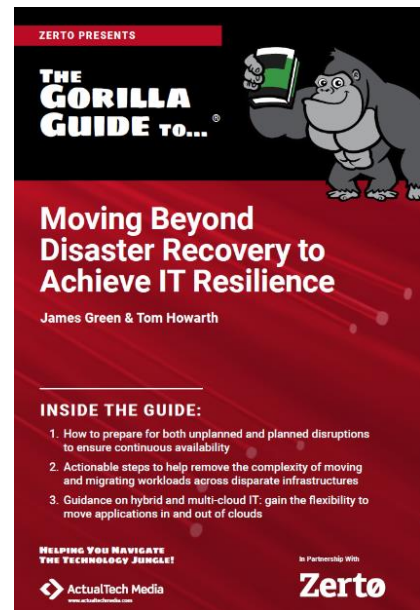
- A variety of vendors have created **converged** and **hyperconverged** infrastructure solutions to reduce the complexity of IT infrastructure deployment:
 - **Converged infrastructure (CI)** pre-packages several servers with a separate storage array.
 - **Hyperconverged infrastructure (HCI)** combines servers with internal storage, software to virtualize that storage, and virtualization software such as VMware vSphere.
- These solutions can be deployed for use in container environments, however, as a class, they are designed for virtualization rather than containers, making bare-metal container deployment impossible in almost all cases.



- The vendors themselves remain largely focused on virtualization.
- The level of support you will get from a vendor for everything in the infrastructure stack above virtualization could be minimal.
- You may have to rely on the open-source community for container and orchestration support.

Moving Beyond Disaster Recovery to Achieve IT Resilience. ¹⁹

- The most exciting benefits for adopters of hyperconverged infrastructure include:
 - Focus on the workload.
 - Data efficiency.
 - Elasticity.
- When hyperconverged infrastructure is first deployed into a data center, it often creates its own little infrastructure silo.
 - This situation often corrects itself over time.
 - As hyperconvergence becomes the norm in the data center, growing and changing is relatively easy.
 - Getting started can involve heavy lifting.



Overcoming Inertia - Mitigating Hyper-convergence's Perceived Challenges. ²⁰

- With a hyper-converged infrastructure (HCI), you simply add new appliances, as you need them. The entire process consists of racking and stacking new appliances, as well as removing old ones (red in following diagram). This represents a new way to handle every infrastructure element because you no longer have to juggle storage, servers, and other supporting systems, including WAN accelerators,

¹⁹ Moving Beyond Disaster Recovery to Achieve IT Resilience; a Gorilla Guide by Zerto in August 2018. Downloaded from the internet in December 2018.

²⁰ Overcoming Inertia j- Mitigating Hyperconvergence's Perceived Challenges by Hyperconverged.Org on Oct-56-2016. Downloaded in December 2018.



Enterprise Architecture Converged and Hyper-converged Infrastructure

backup storage, and the other myriad appliances that currently make up a data center.

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Appliance 1	Appliance 1	Appliance 1	Appliance 1	Appliance 1	Appliance 1
Appliance 2	Appliance 2	Appliance 2	Appliance 2	Appliance 2	Appliance 2
Appliance 3	Appliance 3	Appliance 3	Appliance 3	Appliance 3	Appliance 3
	Appliance 4	Appliance 4	Appliance 4	Appliance 4	Appliance 4
			Appliance 5	Appliance 5	Appliance 5
				Appliance 6	Appliance 6
					Appliance 7
					Appliance 8

- The IT Staffing Challenge: Many companies are not willing to scale their infrastructure staff at the same rate that they scale the infrastructure itself. That results in the IT staff forced to take on more and more responsibility while working with dwindling resources.
 - This situation is one of the very reasons why people consider hyper-converged infrastructure.

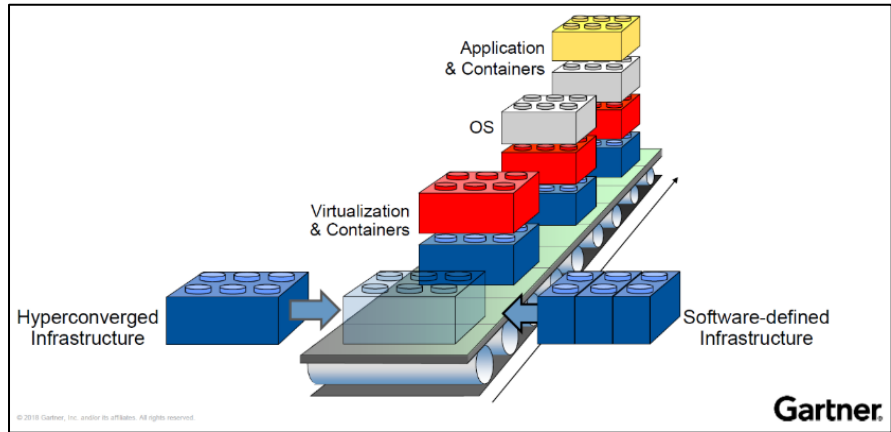
What is the primary reason that you have no interest in deploying hyperconverged infrastructure in the near term? (N=177)



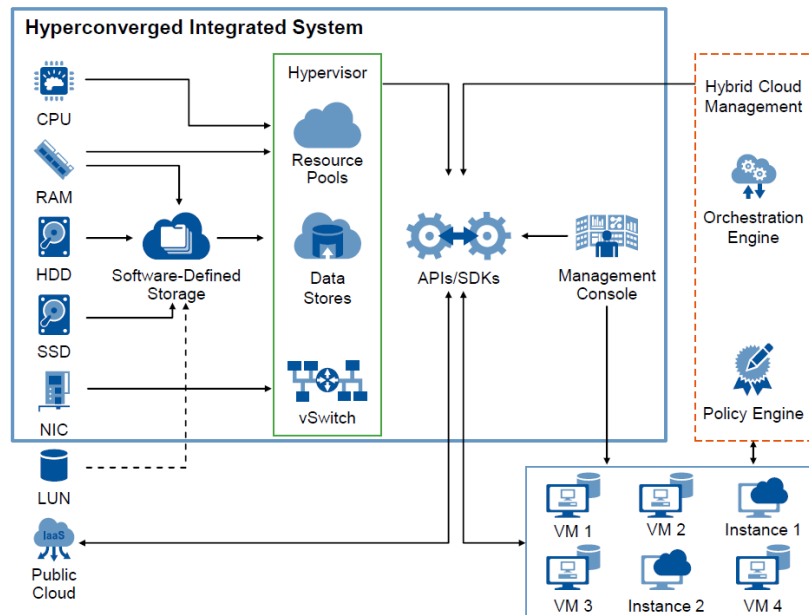


The Data Center is dead – Long live the Data Center. ²¹

- Standardization enables automation.



- Hyper-converged systems unify API's.



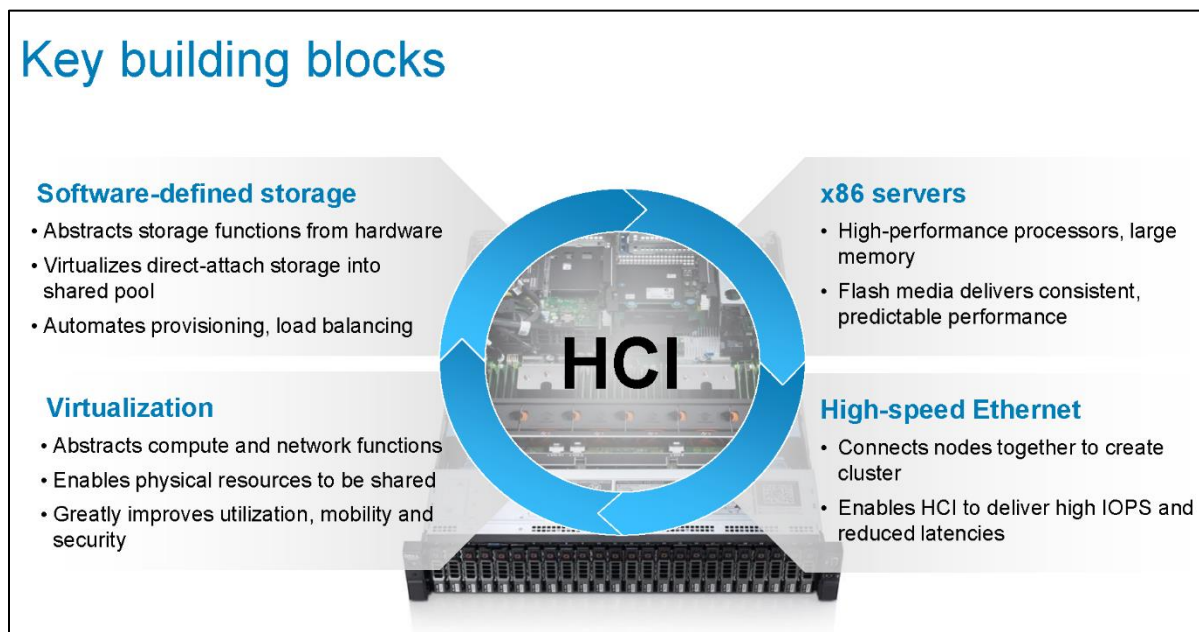
Gartner 2018

²¹ The Data Center is dead - Long Live the Data Center by Gregory Murray of Gartner in August 2018.



Make it Real - Dell Technologies World Conference. ²²

- Key takeaways from the Hyper-Converged Infrastructure segment of the conference:
 - Hyper-converged infrastructure (HCI) is the fastest way to modernize the data center.
 - HCI delivers the business agility, scalability, and simplicity needed to stay competitive.
 - Businesses are transforming IT today with Dell EMC's HCI portfolio.
 - HCI will continue to be a catalyst for transformation – don't be left behind.

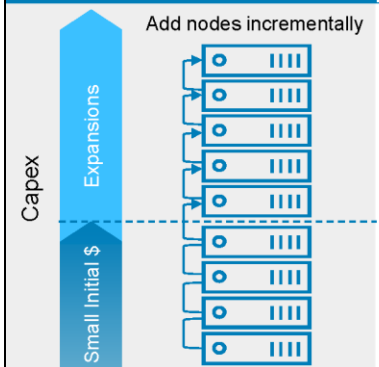


²² Make it Real - Dell Technologies World Conference - May 3, 2018. Obtained from the internet in December 2018.



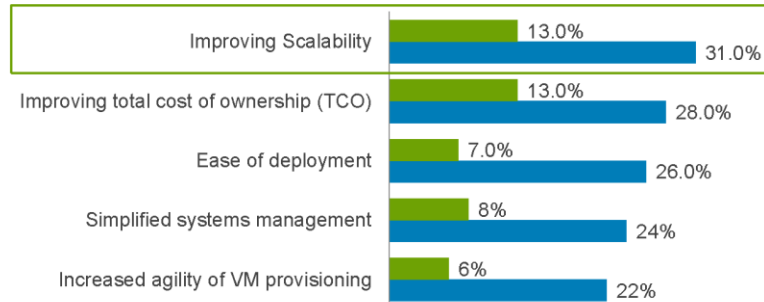
Improving scalability

Pay as you grow



What would you say was the primary reason that you deployed – or are considering deploying – a hyperconverged infrastructure technology solution(s)?

Top 5 Responses



ESG: Hyperconverged Infrastructure Trends, July 2017

■ Primary reason

■ All reasons for deploying

DELLTechnologies | DELL EMC

14 © Copyright 2018 Dell, Inc.

Hyper-Convergence: Infrastructure in a Box. ²³

- Wrapping storage, compute, networking, and virtualization together neatly in one box may seem like a storage administrator's dream come true.
 - For use cases such as virtual desktop infrastructure or remote office, an appliance that can be installed in under an hour and scale by simply adding additional nodes is extremely attractive.
 - Because hyper-converged systems package capacity and compute in one appliance, scaling one usually means scaling both.



²³ Hyper-Convergence: Infrastructure in a Box by TechTarget's SearchVirtualStorage team in 2015. Obtained from the internet in December 2018.



Enterprise Architecture Converged and Hyper-converged Infrastructure

- Enterprises that have not adopted hyper-convergence may also be concerned about vendor lock-in or that integration with existing infrastructure is difficult.
- HCI appliances typically contain between one (1) and four (4) nodes, each of which is an independent server with CPU and memory that share a common server chassis.
 - Hyper-converged clusters usually contain between four (4) and 16 nodes.
 - Hyper-converged infrastructures leverage either virtual SAN or clustered file system software to share storage across multiple nodes.
 - HCI's do not have to include a hypervisor, although all the leading products available include at least one hypervisor option, and many offer two or more.
- Similar to converged systems, hyper-converged architectures simplify the procurement process by providing a single SKU product.
- Most of the success HCI products have seen is in relatively small or isolated environments, like departmental computing or remote locations where technical expertise (or headcount) doesn't support a traditional IT infrastructure.
 - The best case for HCI products are environments having multiple locations and no dedicated IT staff.
- HCI tends to sub-optimize resources resulting in higher costs as the infrastructure gets bigger.
- HCI is by definition, a self-contained, comprehensive IT infrastructure.
 - They do not integrate into an existing data center SAN or compute environment.
 - All subsequent modules must be bought from the same vendor.
 - Most HCI storage options lock the customer into a single vendor.
 - HCI success in departmental, remote offices, and small to medium-sized business space does not always translate into a traditional data center where quick setup and easy operation are less important than scale, flexibility, and cost.
- Do not see HCI systems replacing existing storage and compute infrastructures in medium and larger-sized companies.
 - These organizations typically have more IT expertise and are more interested in consolidating IT systems, not adding new silos to manage.



Enterprise Architecture Converged and Hyper-converged Infrastructure

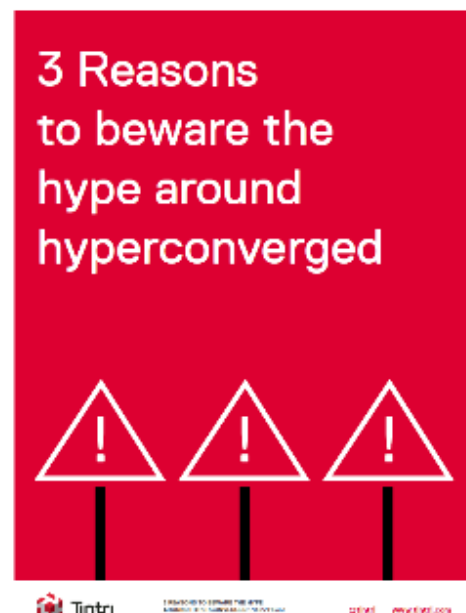
Differences distinguish integration, convergence and hyper-convergence in data center IT systems				
TECHNOLOGY	WHAT IS IT?	BENEFITS TO DATA CENTERS	LIMITATIONS TO THIS APPROACH	EXAMPLES
Integration	Integration is making disparate things work together, including servers, network gear, storage systems and other devices purchased from a variety of vendors.	<ul style="list-style-type: none"> Solves the traditional enterprise computing dilemma where IT architects and administrators assemble, connect, configure and optimize IT equipment and software. 	<ul style="list-style-type: none"> Equipment and software do not natively work together, so the integration process can be costly or time-consuming — or both. Each new addition to the data center requires additional work. 	<ul style="list-style-type: none"> Integration is performed by consultants, value-added resellers and IT integrators.
Converged infrastructure	A vendor preassembles and integrates essential compute, storage and network gear into a single product offering with a common physical enclosure.	<ul style="list-style-type: none"> Accelerates and simplifies data center deployment with fewer errors. Can boost performance and resource utilization. A common management interface and no trial-and-error tuning. Single-vendor service and support. 	<ul style="list-style-type: none"> While the vendor handles integration, users still pay for proprietary hardware and management software. Vendors may update CI boxes' feature sets at a slower rate than their other products. 	<ul style="list-style-type: none"> Dell Active Systems Manager Hitachi Unified Compute Platform HP ConvergedSystem IBM PureFlex NetApp FlexPod Oracle Private Cloud Appliance
Hyper-converged infrastructure	A converged infrastructure with a software-based and -driven architecture that vendors run with white box servers and other generic hardware.	<ul style="list-style-type: none"> Users experience seamless management and expansion of various compute, storage and network devices. Numerous services integrated such as backup, data deduplicatin, WAN acceleration, and SSD storage and cache. 	<ul style="list-style-type: none"> Capacity is expanded simply by adding more boxes, but data centers lose the choice of different vendors' management software or hardware that best suits an application. 	<ul style="list-style-type: none"> VMware Evo:Rail SimpliVity OmniCube and OmniStack Nutanix NX with Acropolis and Prism Maxta MxSP and MaxDeploy Scale Computing HC3 and HC appliance

- All of today's HCI products are based on using a server hypervisor, including VMware vSphere, Microsoft Hyper-V and open source KVM.
- Hyper-converged products can be delivered either as appliances, providing both the hardware and the software, or as software-only products.
- HCI systems may be appropriate for more discrete tasks, such as supporting virtual desktop infrastructure (VDI) environments or hosting other types of standalone applications.
- Being locked in to a select list of hardware may increase the cost of the hyper-converged system offering over time.
- Be aware that while HCI system vendors agree that storage software services need to be implemented in an off-array software stack, many eschew the idea of abstracting capacity management from the storage array controller.
 - This is a noteworthy limitation of many HCI offerings, since it means capacity management is a separate activity that must be performed on each storage device, often requiring specialized tools and skills.



Three (3) Reasons to Beware the Hype around Hyperconverged. ²⁴

- Conventional HCI combines storage, compute, and virtualization on each node – and placing storage on top of the hypervisor – in an approach that promises simplicity and lower cost.
 - While this may make sense for small deployments, Tintri strongly believes that most enterprises will be better served with separate servers and virtualization-centric storage when deploying infrastructure at scale.
- The HCI Tax:
 - Conventional HCI implementations generally require you to have similar CPU, memory, and storage configuration on all the nodes in a cluster
 - For storage, this is not considered a best practice because the imbalance can cause storage hot spots and bottlenecks.
 - You end up spending more – and having valuable resources sitting idle.
 - This effect is so well known it is often referred to as the “HCI tax.”
- HCI may also add to your licensing costs.
- For example, Microsoft SQL Server and Oracle database are licensed based on the number of CPUs on a node.
 - It does not matter if those CPUs are actually being used for storage, your license costs are still based on total CPUs on the node.
 - Because you’re dedicating a lot of resources on each node to storage – you end up needing more nodes to get enough vCPUs for all your database instances.



²⁴ Three (3) Reasons to Beware the Hype around Hyperconverged by Tintri. Obtained from the internet in December 2018.



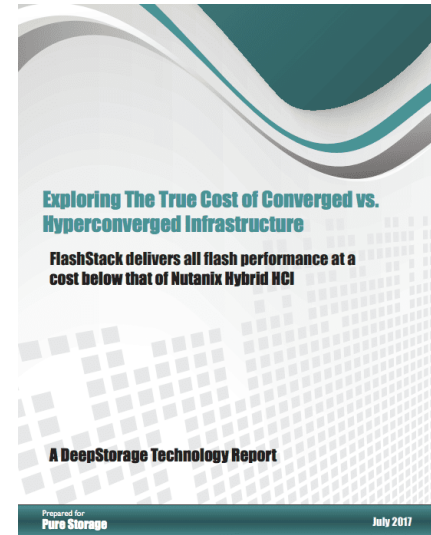
Enterprise Architecture Converged and Hyper-converged Infrastructure

- Conventional HCI architectures lag behind best of-breed external storage systems – both in hybrid flash and all-flash configurations – in a number of important performance metrics such as latency and IOPS performance.
 - The main reasons for choosing all-flash storage are: 1) Dramatic reductions in the latency of each IO operation; 2) Big increases in total IOPS; 3) More predictable performance for every IO.
 - External storage systems do a much better job delivering all three of these than HCI.
- One of the most often-claimed advantages of conventional HCI is that it decreases complexity. The “simplicity” of HCI architectures comes at a price: 1) Increased troubleshooting complexity; 2) Greater operational risk.
- The HCI Snowball Effect
 - A single HCI failure can trigger much larger problems. When a host fails for any reason, it has the following effects:
 - Reduces available resources for compute and storage
 - Reduces available flash in hybrid configurations
 - Results in a double dip.
 - Flash for VMs from the failed node must be rewarmed. The extra pressure causes data from existing VMs to be evicted. Thus, VMs from both the failed and surviving nodes suffer;
 - The process repeats on the reintroduction of the failed node.
 - Failure of even a single component, such as a flash drive, can cause an entire node to collapse. The result is a far greater impact on operations than when storage is decoupled from the host.



Exploring the True Cost of Converged vs. Hyperconverged Infrastructure (HCI). ²⁵

- We set out to see if the HCI camp's claim of lower costs actually hold water, especially as cluster sizes exceed four to six nodes.
- We concede that:
 - HCI, by reducing the number of decisions and options, simplifies the acquisition process.
 - Reducing server, hypervisor, and storage management to a single console could add value by freeing up staff to work on other tasks – or provide quantifiable savings by enabling staff reductions.
- Discounting when creating the test environment:
 - Only a fool, a state government, or an analyst looking for a headline would pay list price when spending over a million dollars on an IT system. Enterprise IT buyers expect significant discounts.
- Hyperconverged solutions use the same processor to manage storage and run user workload virtual machines.
 - This means any CPU cycles or host memory used for storage management or data services are unavailable for user VMs.
 - This reduces the total number of user VMs any given host can support.

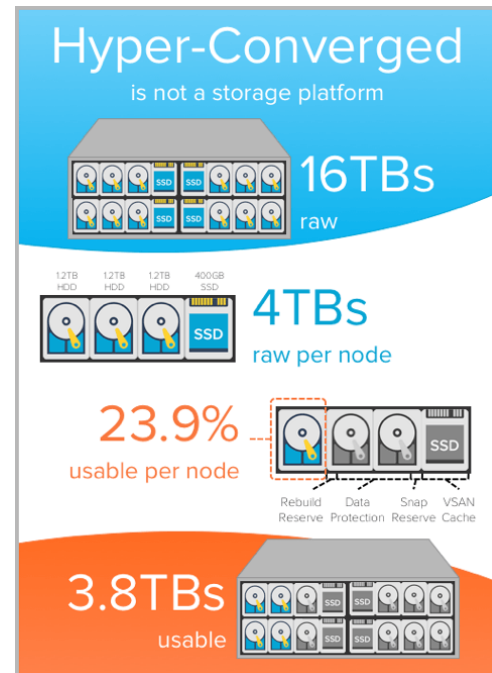


²⁵ Exploring the True Cost of Converged vs. Hyperconverged Infrastructure by Pure Storage - a DeepStorage Technology Report in September 2017. Obtained from the internet in December 2018.



Enterprise Architecture Converged and Hyper-converged Infrastructure

- Integrated Host Management
 - Hyperconverged appliance advocates, including Nutanix, contend that HCI simplifies management by merging hypervisor, storage software and server firmware management into a common user interface – this is true.
 - However, Nutanix for example, has not integrated the server and storage management features of Prism into VMware's vCenter.
 - vSphere users, who still make up a significant majority of Nutanix users, will have to switch back and forth between the vCenter management console and Prism.
 - Prism does provide some basic information on the vSphere environment but we do not consider it a full replacement for vCenter especially in organizations run vSphere already.
- We compared the cost of a typical HCI solution from Nutanix, a leading vendor in the HCI space, to FlashStack, which Cisco and Pure Storage call a next-generation converged infrastructure solution.
 - Revealed that the all-flash Flash-Stack solution was at worst approximately 25% more expensive than the hybrid Nutanix alternative.
 - When we adjusted our model to account for the greater data reduction capabilities we believe the Pure FlashArray would provide and the CPU consumption by Nutanix' storage CVM, the FlashStack solution was as much as 40% less expensive than the Nutanix.





Considerations for the Next Phase of Hyperconverged Infrastructure. ²⁶



- In the past three to five years (2011-2016), hyperconverged platforms have become legitimate alternatives to traditional storage systems.
 - They have shown enterprises that storage need not be confined to proprietary external arrays.
- Initial deployments of HCI largely focused on the midrange segment of the market, where IT often lacks storage expertise, and which are not bound to a specific storage supplier.
 - For these early customers, HCI's ability to deliver key storage functions such as snapshots/cloning, replication, and flash acceleration without the need for storage SAN expertise has been a game changer, especially with IT professionals being pushed to broaden their skill sets to handle increasing workloads in datacenters.

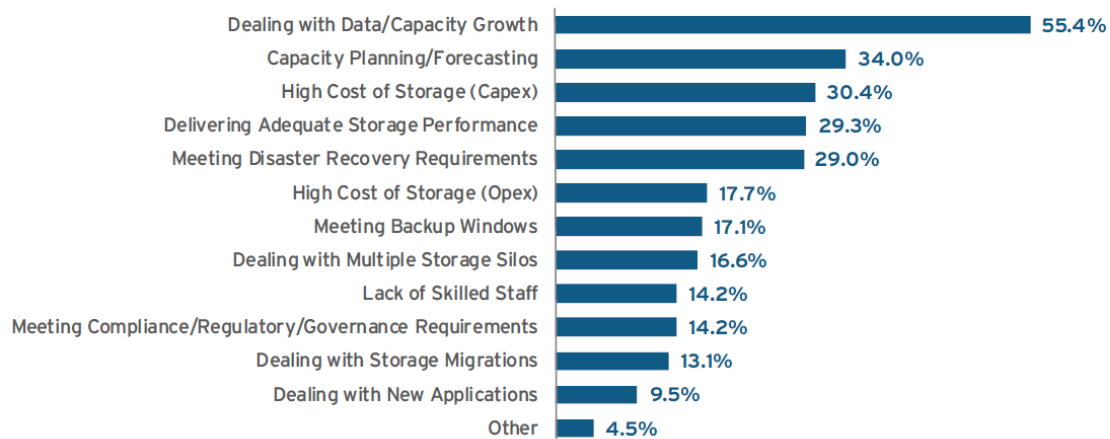
²⁶ Considerations for the Next Phase of Hyperconverged Infrastructure by Cisco and 451 Research in March 2016. Obtain from the internet in December 2018.



PATHFINDER REPORT: CONSIDERATIONS FOR THE NEXT PHASE OF HYPERCONVERGED INFRASTRUCTURE

Figure 3: Top Storage Pain Points

Q. What are your organization's top three pain points from a storage perspective? n = 639



- The increased efficiency, agility, and adaptability of next-generation HCI architectures can help organizations deliver a number of key business benefits such as:
 - Meeting performance and uptime SLAs.
 - Provisioning (scale-up) acceleration.
 - Faster insights.
 - Raised customer expectations.

Next Generation Data Centers: Hyperconverged Architectures Impact on Storage. ²⁷

- Hyper-convergence is a type of infrastructure system with a software-centric architecture that tightly integrates compute, storage, networking and virtualization resources and other technologies from scratch in a commodity hardware box supported by a single vendor. ²⁸
- Hyper-convergence creates elasticity in scaling an overall infrastructure environment.
- Enable movement on and off prem.

²⁷ Next Generation Data Centers: Hyperconverged Architectures Impact on Storage by EMC in 2015. Obtained from the internet in December 2018.

²⁸ Definition obtained by EMC from Search Virtual Storage at TechTarget dot com in 2015.



**Pictorial Insight of
Converged Infrastructure
and
Hyper-converged Infrastructure
Technologies ²⁹**

²⁹ Obtained through various sources as found on the World Wide Web / Internet. December 2018.



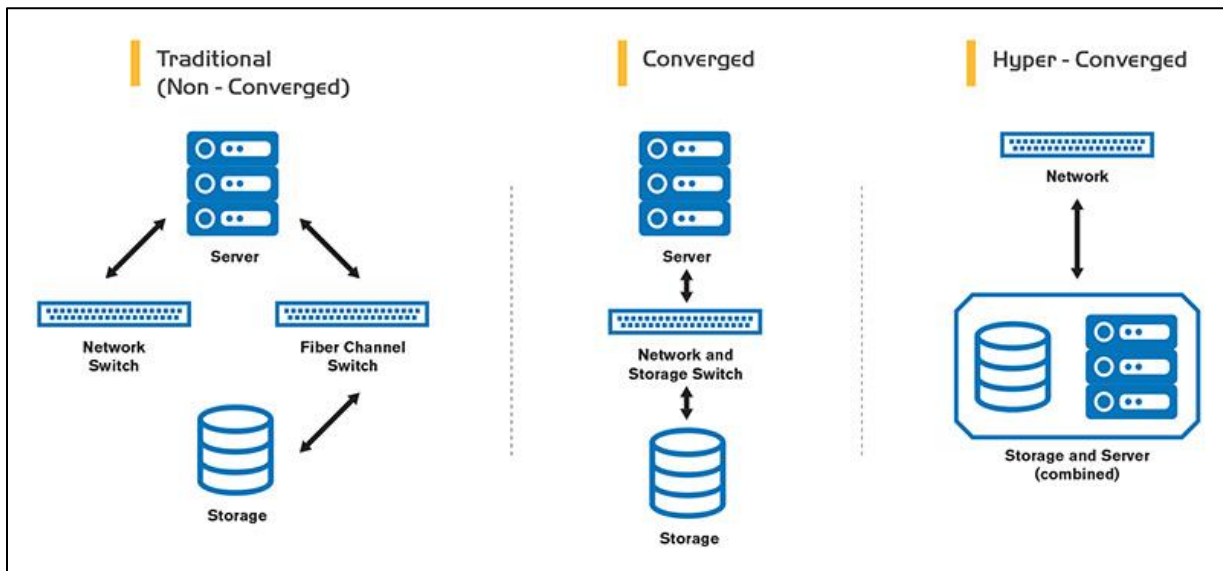
Converged Infrastructure

Converged Infrastructure

Is:
A way to package up a lot of IT into one simple solution.

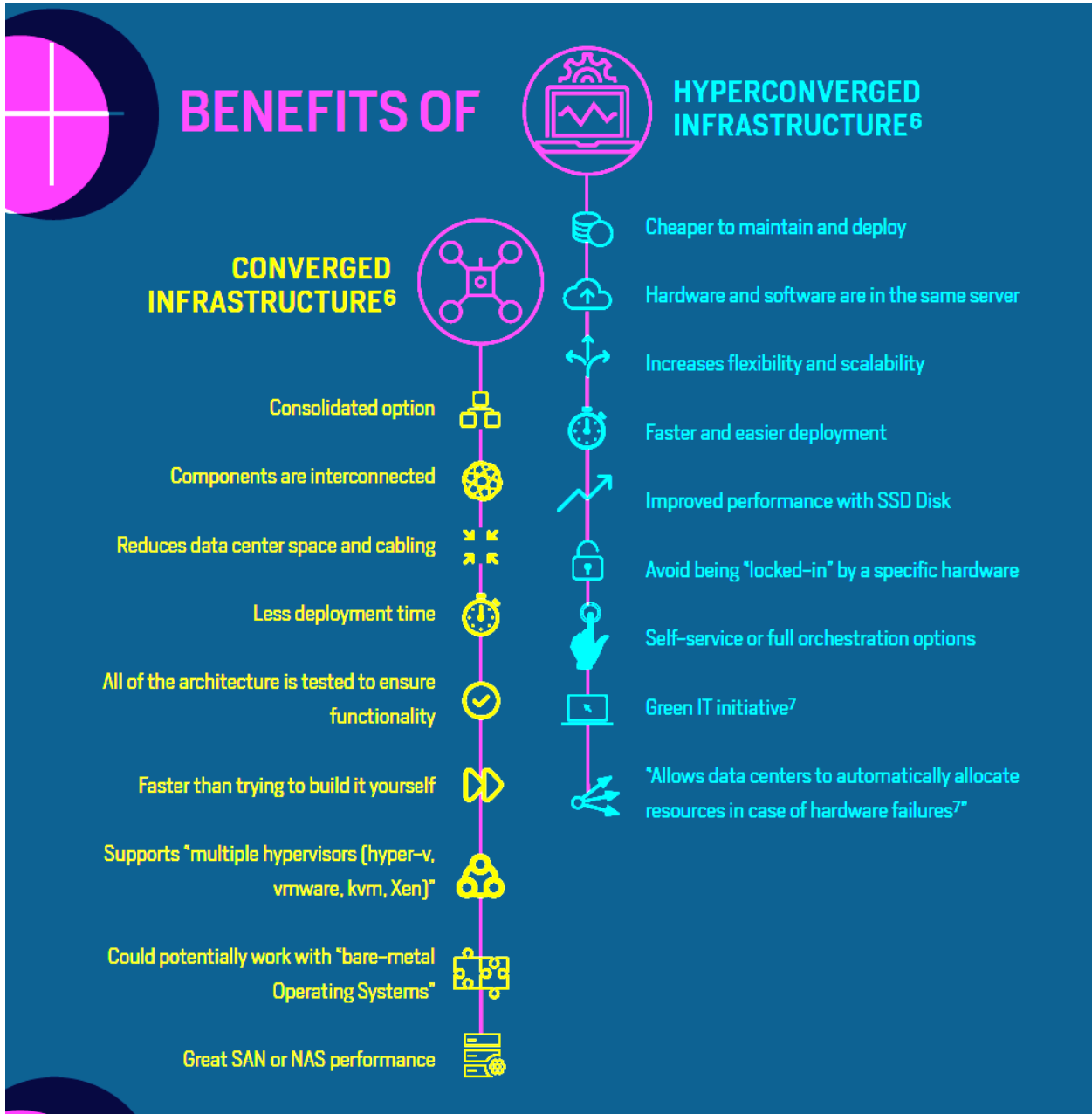
Is not:
Where all the wires meet.

(The graphic shows a server rack with a dense, chaotic mess of multi-colored cables plugged into the back, illustrating the 'where all the wires meet' scenario.)



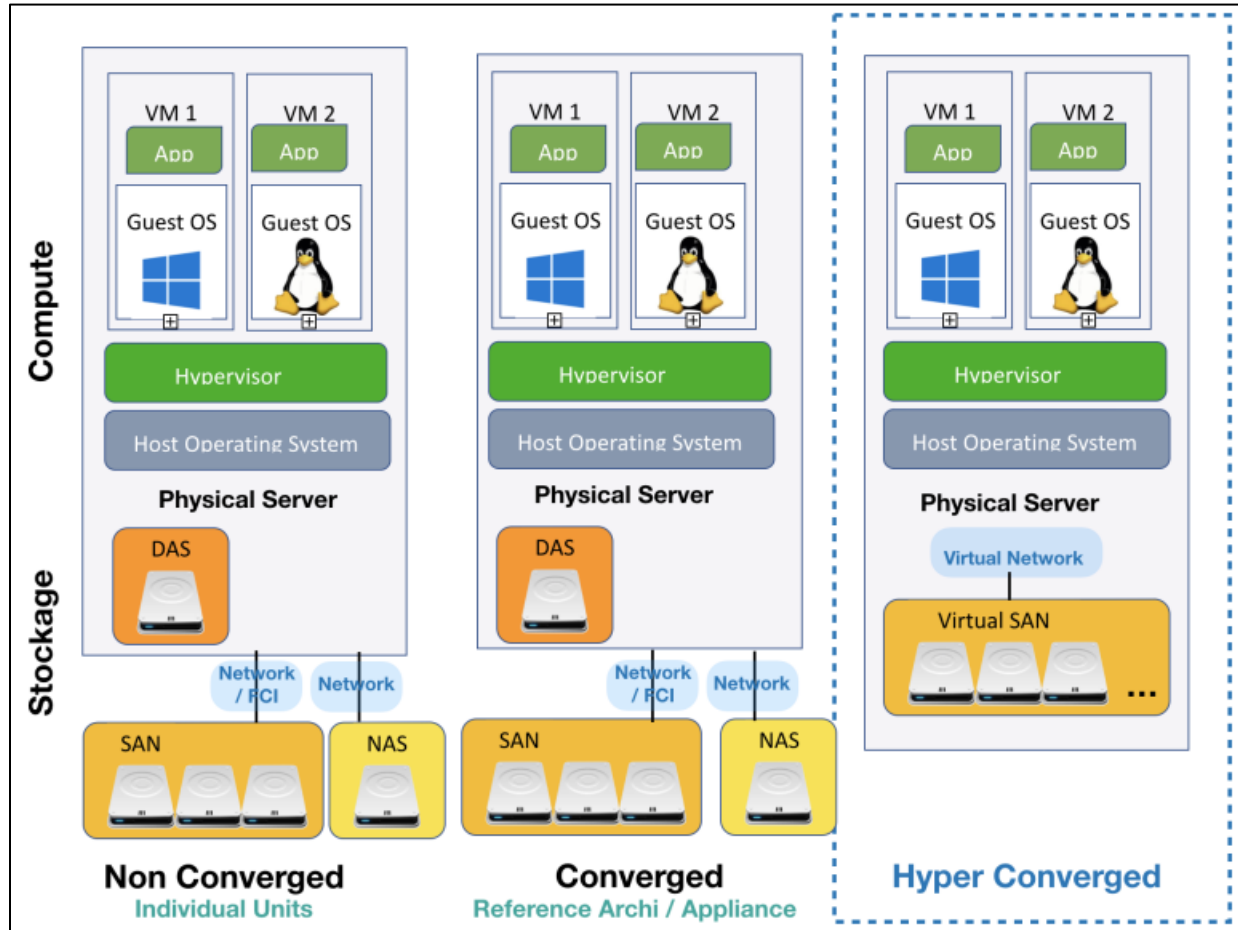


Enterprise Architecture Converged and Hyper-converged Infrastructure





Enterprise Architecture Converged and Hyper-converged Infrastructure

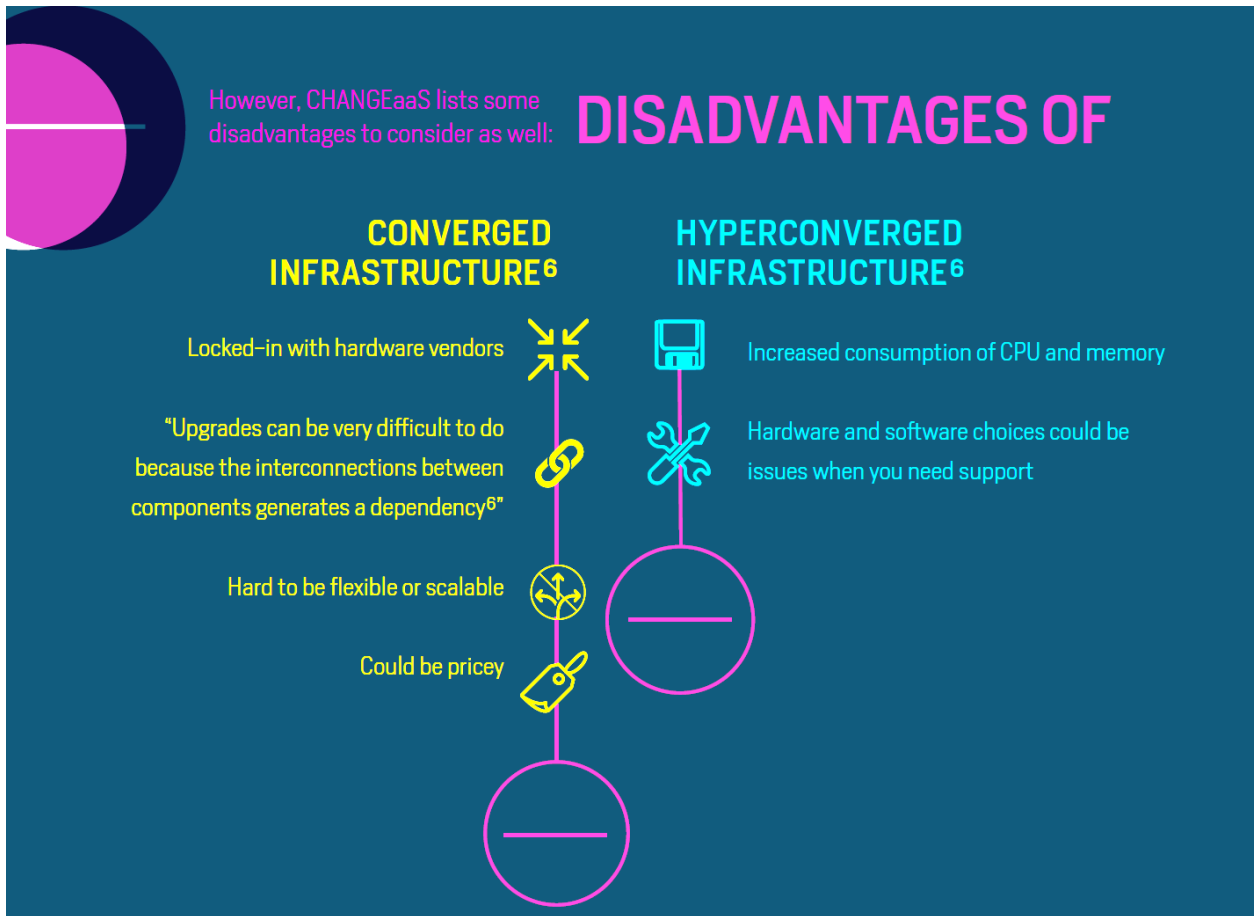




Converged vs Hyperconverged

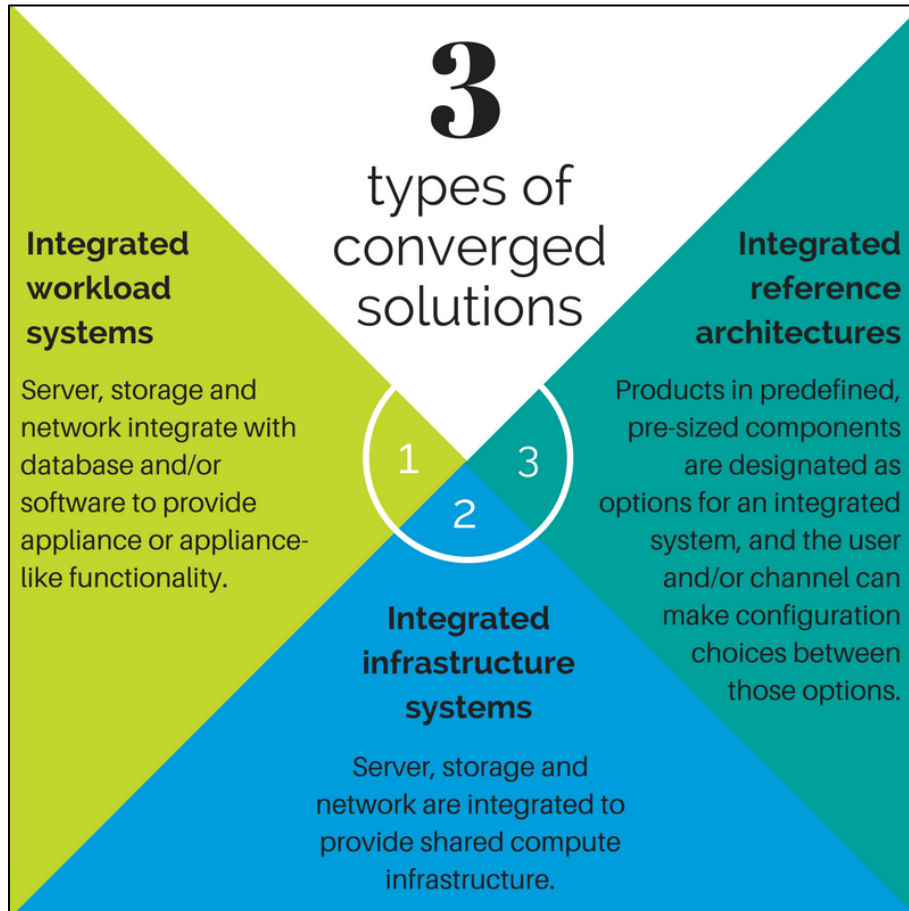
- ❑ Converged infrastructures
 - ❑ Multi-protocol NAS boxes
 - ❑ Combined block/file with iSCSI

- ❑ Hyperconverged
 - ❑ SW defined
 - ❑ Client and server run together



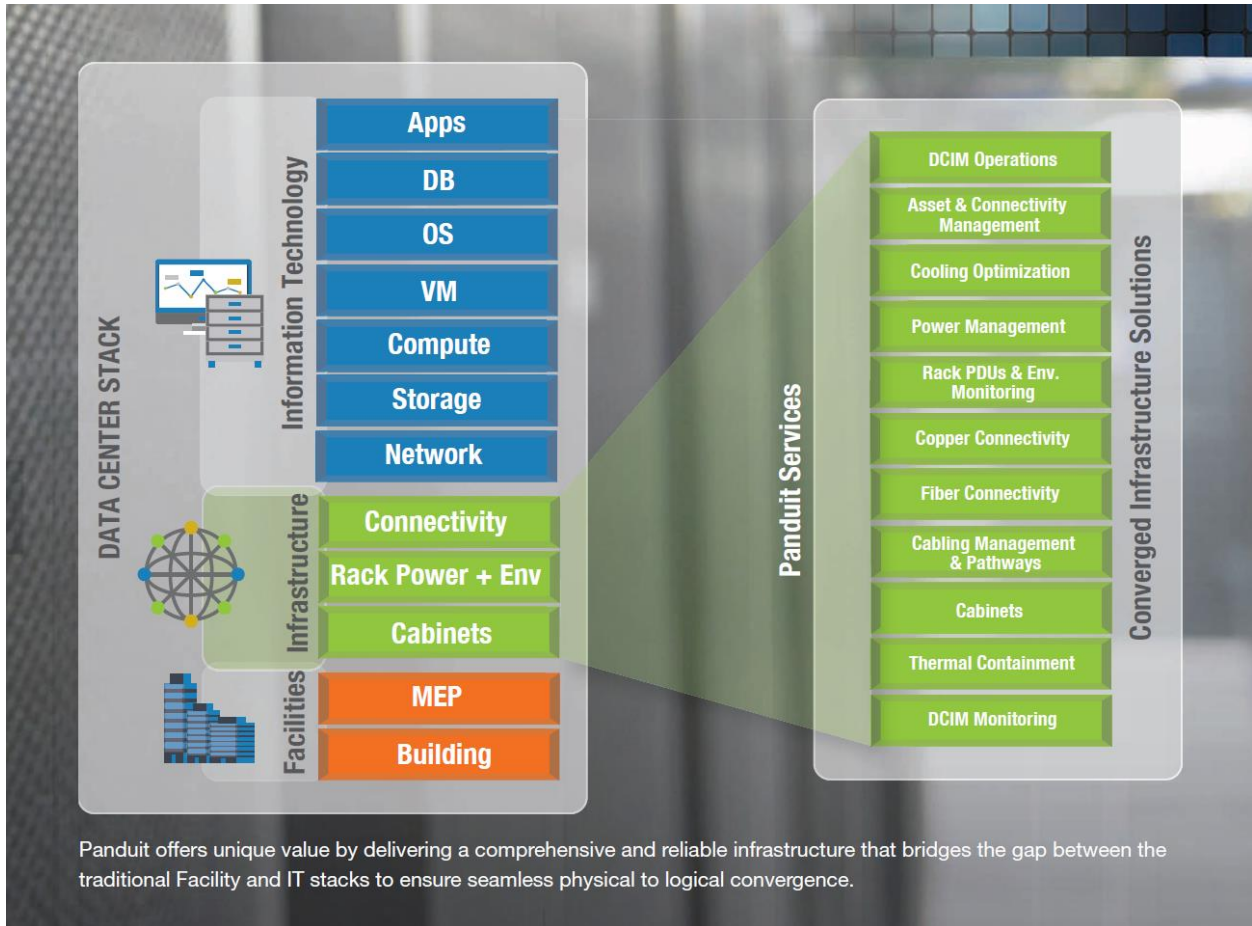


Enterprise Architecture Converged and Hyper-converged Infrastructure





Enterprise Architecture Converged and Hyper-converged Infrastructure

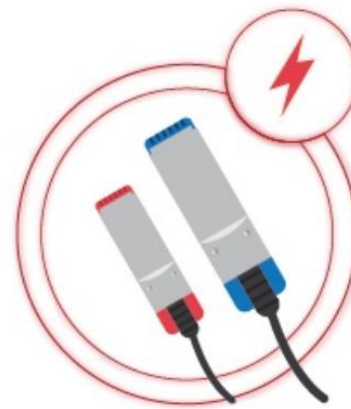




CONNECT STORAGE, NETWORK AND SERVER SIMPLY

IDC also reported the steady growth of larger 10 and 40 Gigabit Ethernet usage in data centers over the last half decade demonstrates how these facilities are searching for “scalable, cost-effective connectivity infrastructure” and a “lower cost per unit of bandwidth.”

Converged infrastructure offers the enhanced connectivity businesses look for by reducing complexity between different facility components.

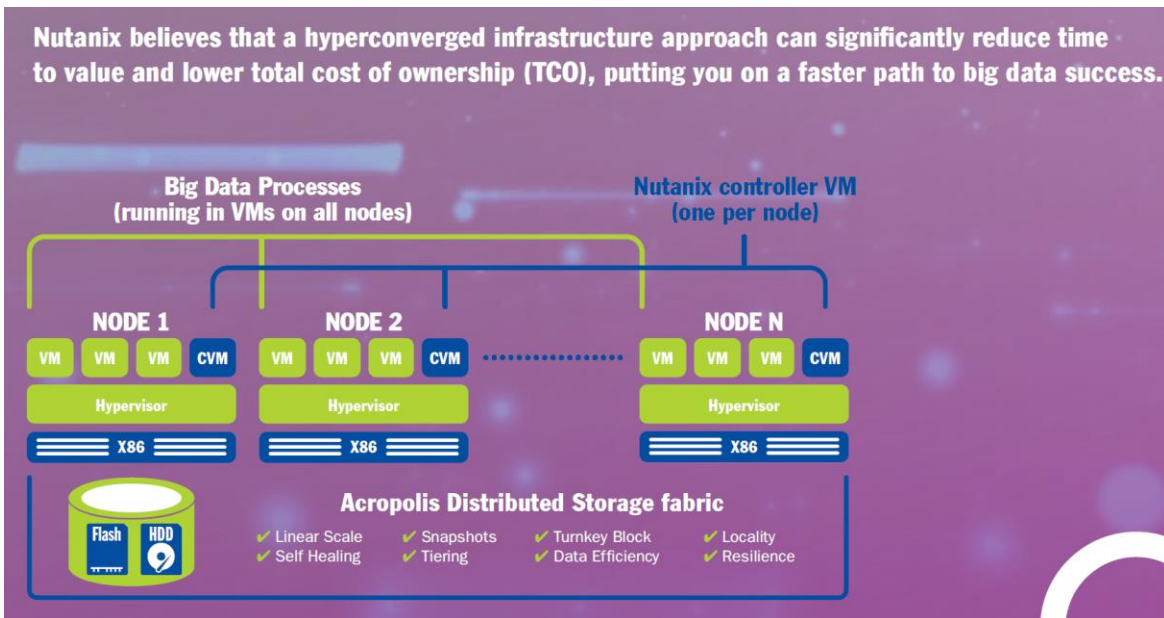
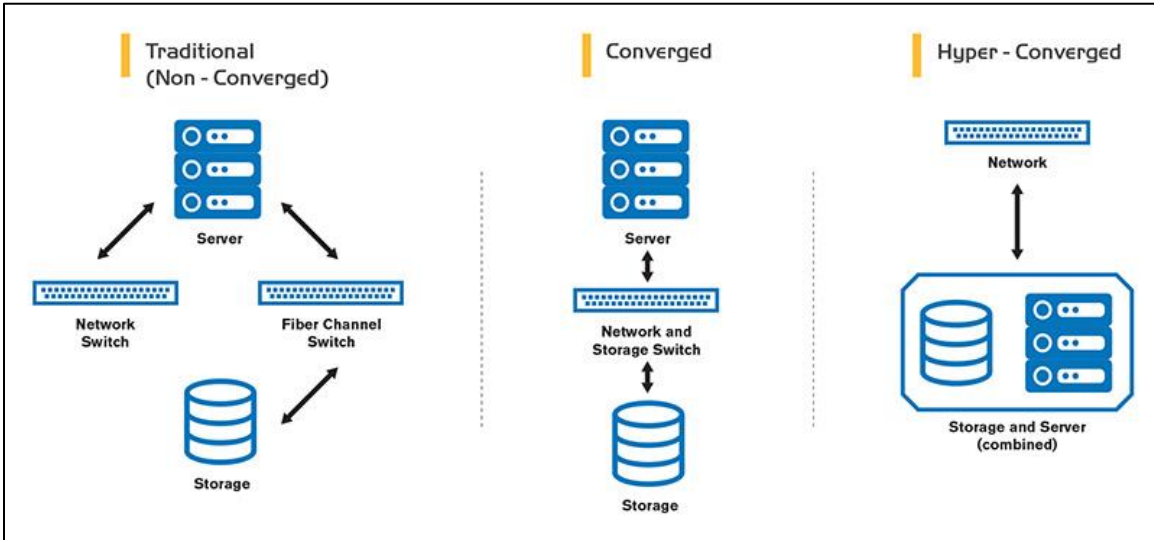




Enterprise Architecture Converged and Hyper-converged Infrastructure

Hyper-converged Infrastructure

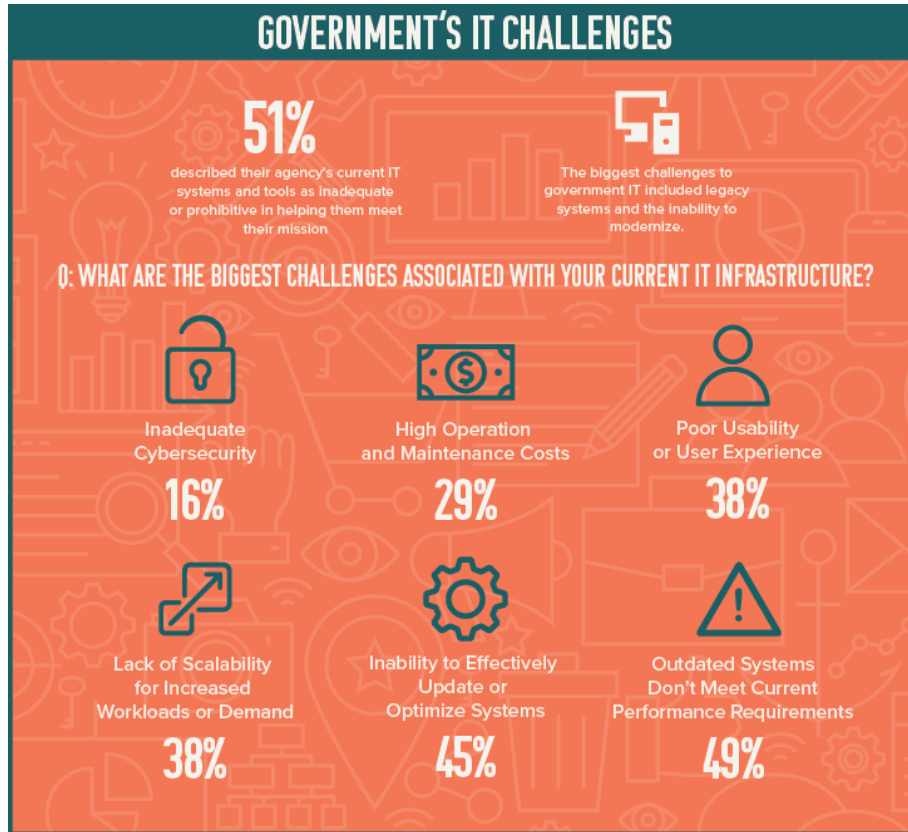
- The following diagrams are to assist with understanding hyper-converged infrastructure.



Big data hyper-converged infrastructure approach



Enterprise Architecture Converged and Hyper-converged Infrastructure



HCI takes CI benefits to the next level

Simpler architecture | More automation | Supports most workloads

<p><i>For existing lifecycle management processes</i></p> <p>Focus on reducing acquisition costs</p> <p>3x market growth rate</p> <p>VMware</p>	<p><i>Turnkey appliance with full lifecycle simplification</i></p> <p>Jointly engineered with VMware, powered by vSAN</p> <p>3x market growth rate</p> <p>VMware</p>	<p><i>Easiest and fastest way to stand up a VMware SDDC</i></p> <p>Ultimate rack-scale HCI for VMware hybrid cloud</p> <p>VMware</p>	<p><i>For Microsoft Hyper-V on Storage Spaces Direct</i></p> <p>Validated configurations for building Microsoft HCI</p> <p>Microsoft</p>	<p><i>Purpose built HCI for Microsoft Azure Stack</i></p> <p>Extend Azure Cloud on premises with Azure Stack</p> <p>Microsoft</p>	<p><i>When hypervisor choice is a requirement</i></p> <p>For when customer demands Nutanix</p> <p>Mixed Hypervisor</p>	<p><i>Most flexible HCI rack-scale system</i></p> <p>When performance and scalability are top priority</p> <p>Mixed Hypervisor</p>
<p>vSAN Ready Node</p>	<p>VxRail</p>	<p>VxRack SDDC</p>	<p>Microsoft Storage Spaces Direct Ready Node</p>	<p>Cloud for Microsoft Azure Stack VxRack AS</p>	<p>XC Series</p>	<p>VxRack FLEX</p>

DELLTechnologies | DELL EMC



Enterprise Architecture Converged and Hyper-converged Infrastructure

THE HYPERCONVERGED SOLUTION

HCI

HCI consolidates networking, compute and storage functions in a single box.

According to public servants who do know the benefits of this next generation architecture, HCI is the path forward and provides the benefits agencies seek. However, many government workers don't know the benefits of HCI or whether their agency will pursue it.

43%

unsure of the benefits offered by HCI

58%

unsure if their agency used or planned to use HCI

HCI can provide agencies with the flexibility, scalability, security, and performance that government needs to meet mission demands. That's why it's critical for IT professionals to understand the benefits of next generation architectures and how to get started with HCI.

Even Faster Adoption

“HCI is the fastest growing market of all the multi-billion-dollar storage segments.”

- Eric Burgener, IDC

Growth of Edge Computing

“Currently, around 10% of enterprise-generated data is created and processed outside a traditional centralized data center or cloud.” By 2022, Gartner predicts this figure will reach 50%.

- Santhosh Rao, Gartner

Hardware Advancements

- Faster NVMe drives
- High memory processors
- 25 GbE connectivity
- Higher efficiency (power, cooling, etc.)

Software Innovation

- Hybrid cloud
- New advanced data services
- Enhanced serviceability
- AI / ML for self-diagnosis



5 SURPRISING FACTS ABOUT HYPERCONVERGENCE

Hyperconverged infrastructure (HCI) is touted as **“THE NEXT BIG THING”** in virtualization, but what does that really mean? Read on to learn five facts you might not know about hyperconvergence—and why it might make a lot of sense for your organization.



THE “HYPER” IS MORE THAN HYPE

These days, it seems like everyone has jumped on the HCI bandwagon. However, the term “hyperconverged” has a very specific meaning:

HYPER- /'hɪpər/

1. Shortened form of hypervisor

CONVERGED |kən'veɪrd/

1. Combined server and storage technology



Many converged infrastructure vendors like to say they offer an HCI solution, while still relying on separate, third-party hypervisors.

**DON'T BE FOOLED BY
THESE PRETENDERS...**





Enterprise Architecture Converged and Hyper-converged Infrastructure

EFFICIENCY COUNTS

INEFFICIENCY = LESS VMS

For example, some HCI vendors use virtual storage appliance (VSA) models that **consume huge amounts of RAM and CPU** (leaving less room for application VMs).

One HCI vendor reserves **>100 GB of RAM per node, just for storage I/O overhead**

● = 1 GB

? A BETTER APPROACH? An entirely new storage architecture designed just for HCI. Vendors use this model to deliver storage efficiently to the hypervisor—resulting in overall hardware efficiency for you.

TRUE HCI IMPROVES DATA PROTECTION

THE SIMPLE FACT: More data protection vendors = More opportunity for data loss

But since HCI solutions often include comprehensive backup, replication, and disaster recovery tools, they provide a single source for data protection—**AND LESS NEED TO WORRY ABOUT DATA LOSS.**



MORE MONEY IN YOUR POCKET

Yes, the cost of acquisition can be high with HCI solutions, but the operational savings make it completely worth it. **This includes:**

- ENORMOUS SAVINGS** on implementation and scaling costs, since the traditional integration work (i.e., the convergence) has already been done for you
- LOWER MANAGEMENT/MAINTENANCE COSTS** over the lifecycle of the solution

The ROI of an HCI solution is usually much more favorable than with a traditional server + SAN + hypervisor solution.

SCALE CAPACITY, ANYTIME

Some vendors let you customize each appliance in an HCI cluster. For example, when you add a new node, you can increase the storage capacity.

You also have the flexibility to adjust the RAM or CPU to meet your needs.

RAM

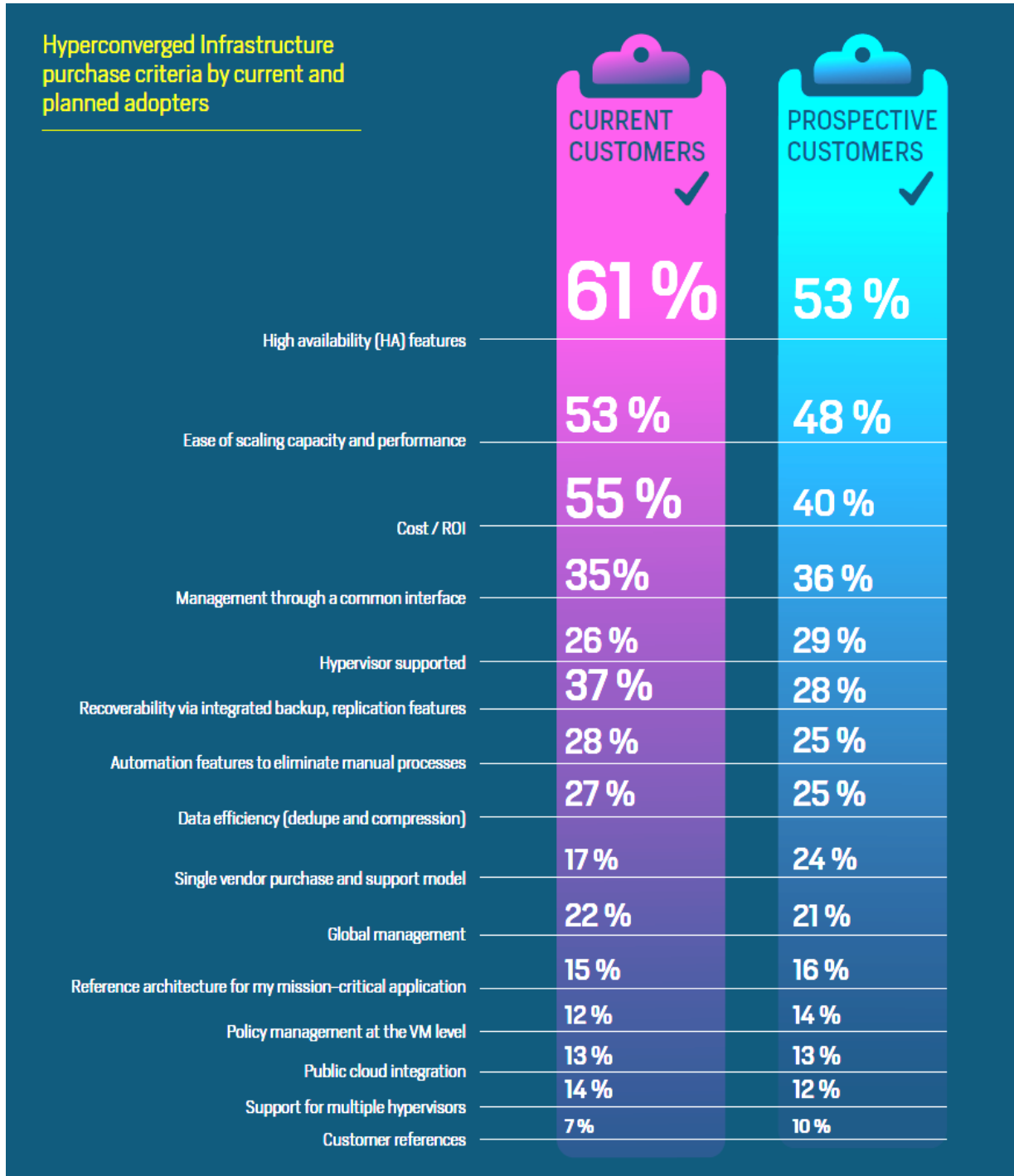
CPU

THE RIGHT SOLUTION RIGHT NOW



Enterprise Architecture Converged and Hyper-converged Infrastructure

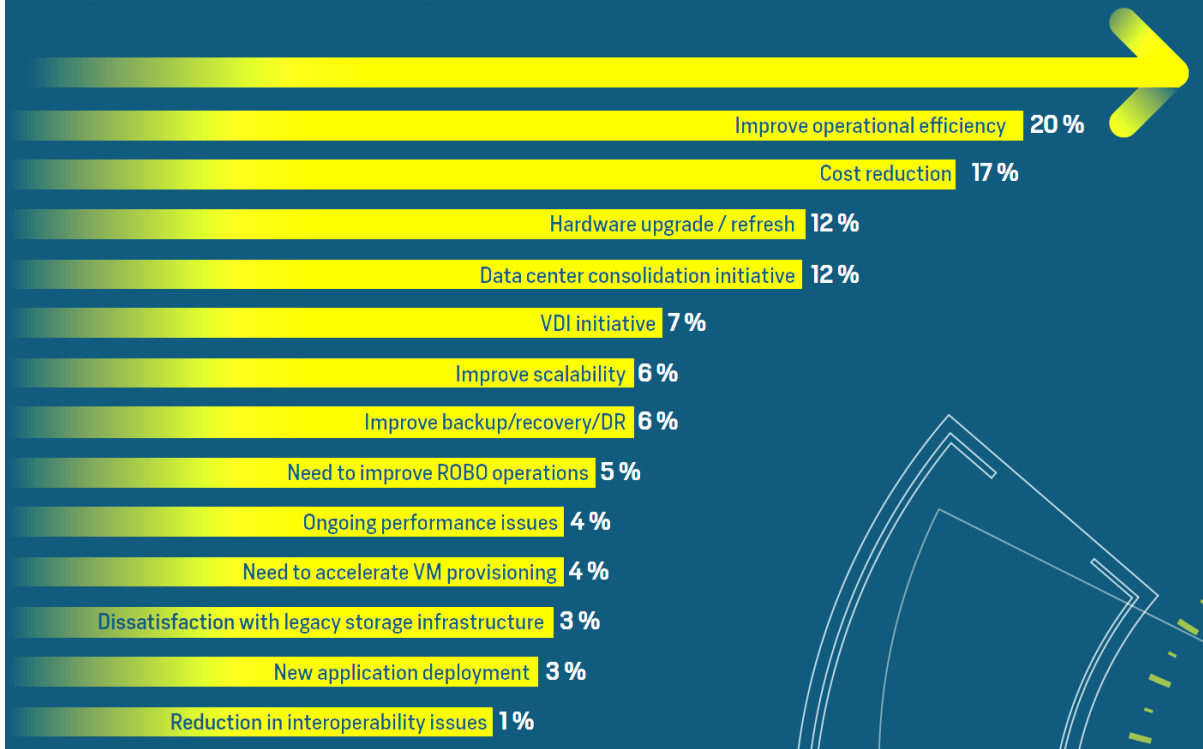
Hyperconverged Infrastructure purchase criteria by current and planned adopters





Enterprise Architecture Converged and Hyper-converged Infrastructure

Which is the primary driver for your interest in hyperconverged infrastructure?



Over **60%** of companies **have deployed or will deploy HCI** within two years.¹

For some very simple reasons

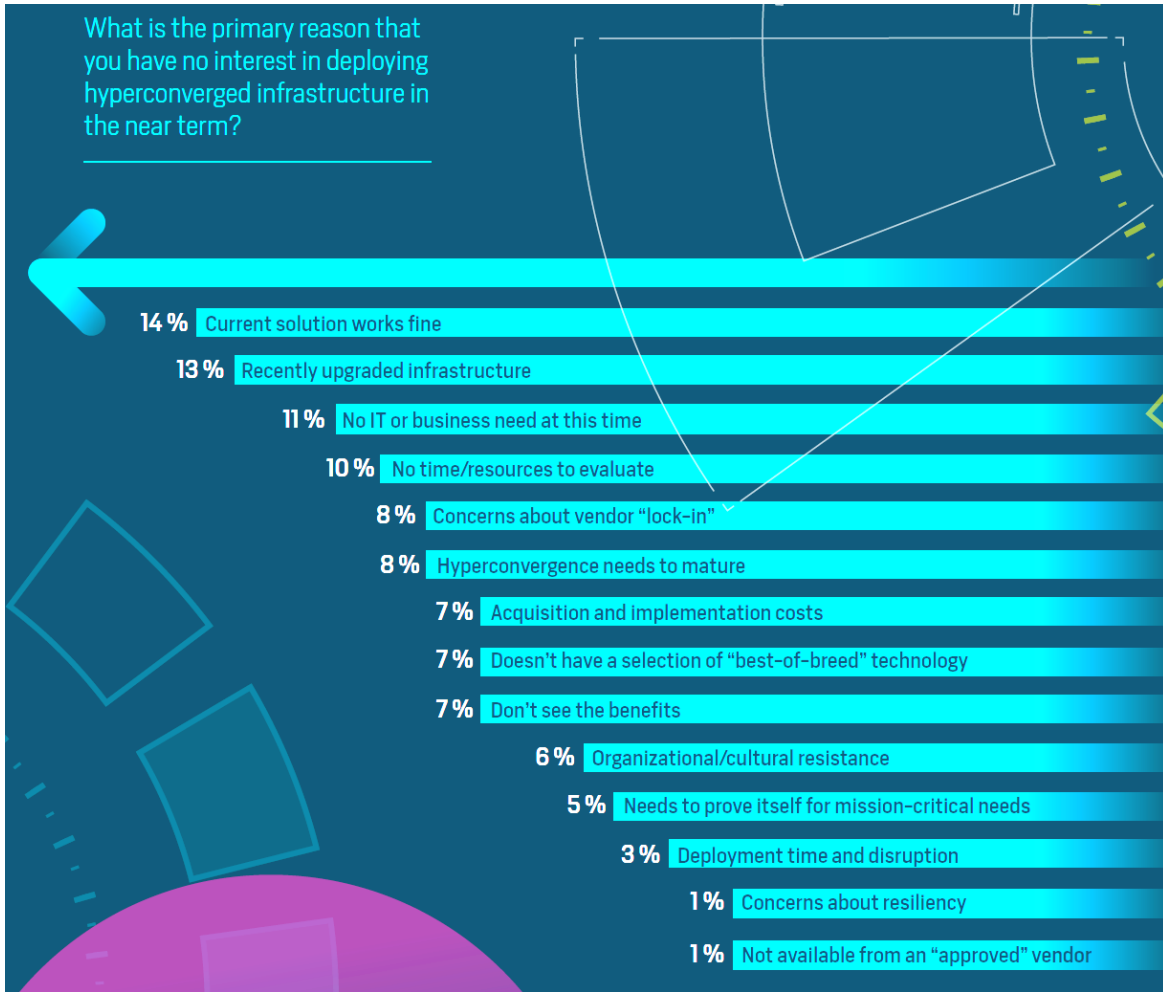


"...an extremely cost-efficient way to deploy capacity for general-purpose IaaS..."

Forrester Research⁶



Enterprise Architecture Converged and Hyper-converged Infrastructure





Enterprise Architecture Converged and Hyper-converged Infrastructure

Simplified IT management

Traditional SAN



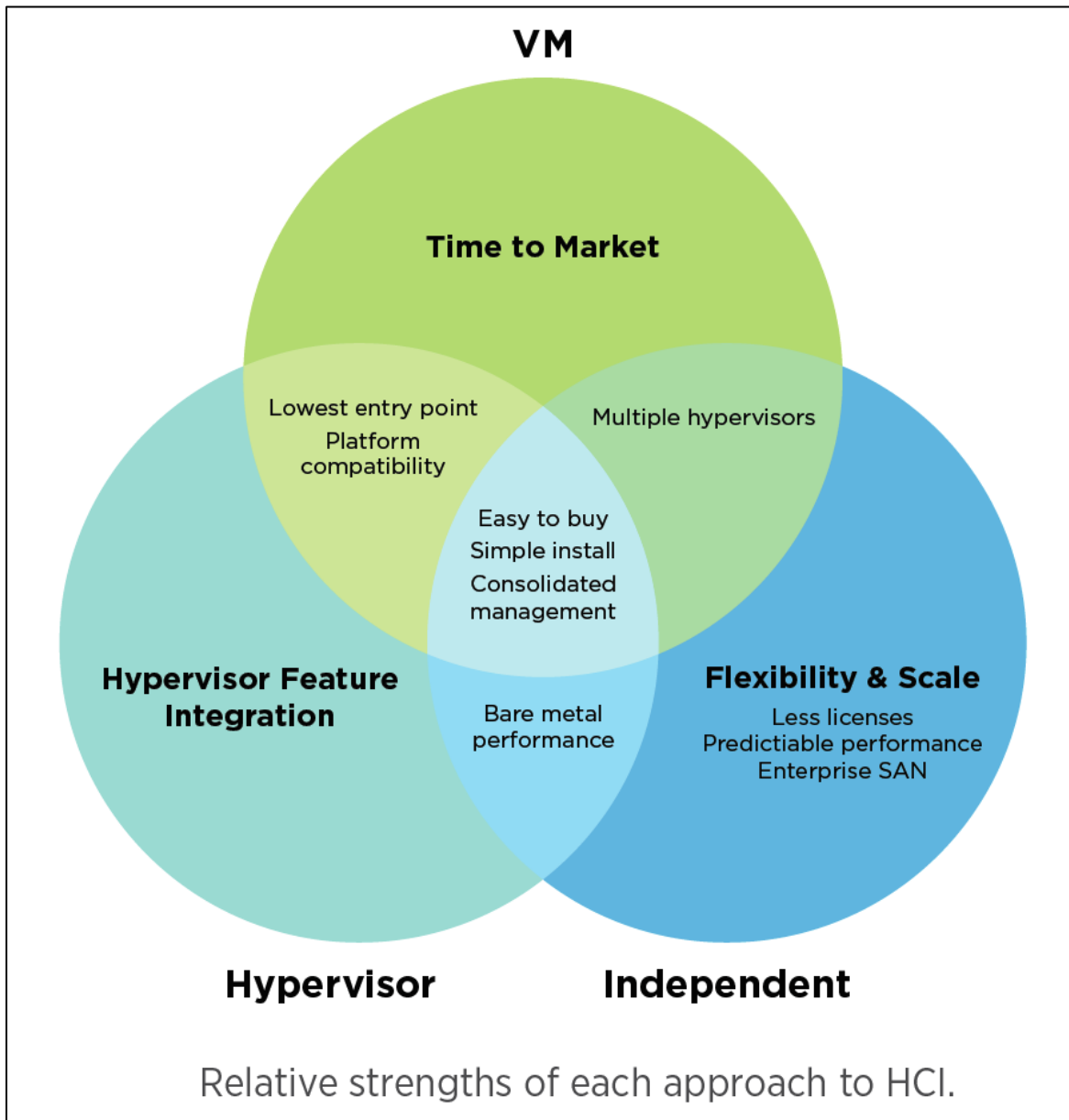
Hyper-Converged



Dell Technologies | Dell EMC



Enterprise Architecture Converged and Hyper-converged Infrastructure



HCI Architectures Guide by NetApp-Guide in September-2018.



What is Hyperconvergence?

Hyperconvergence is a way of constructing private data centers that seeks to emulate public cloud consumption in terms of its operational simplicity, economic model, and scaling granularity. And it provides all of this without sacrificing the performance, reliability, and workload availability that businesses today expect.



The most exciting benefits for adopters of **hyperconverged** infrastructure include:

- **Focus on the workload:** For too long, infrastructure policy and management have focused on the wrong constructs. Managing LUNs and hosts and clusters is old school. In the post-cloud era, the workload should be the focus.
- **Data efficiency:** The nature of hyperconverged infrastructure lends itself well to a high degree of data reduction by way of global deduplication and compression, which leads to more approachable requirements for storage capacity, network bandwidth, and IOPS.
- **Elasticity:** The beauty of the cloud is that if you need to scale out or in, you just click a few times and it's done. Hyperconvergence focuses heavily on making scaling easy, and in bite-sized units; this model stands in stark contrast to the 3- or 5-year bulk purchasing model of traditional IT infrastructure.

Modernization Without Fear

Zerto technology is agnostic with regard to hypervisor, storage, and even cloud.

