



Gridstore HyperConverged Private Cloud Solution Offers Breakthrough Density, Economics, and Price-to-Performance

Published by: Value Prism Consulting

Sponsored by: Gridstore, Inc.

Publish date: August 2015

Abstract: Private Cloud solutions market has seen new converged infrastructure offerings emerge from large technology vendors to startups, each trying to grab a piece of the fast growing multi-billion dollar market. Each of the vendors offer customizable yet proprietary compute, storage, and networking configurations, combined with their preferred systems and management software stack. This makes it difficult to compare the systems on a price-to-performance scale. Value Prism Consulting, a management consulting firm, was engaged by Gridstore, Inc. to review and contrast private cloud solution offerings from four leading converged infrastructure vendors based on publicly-available costs and specification data. On a price-to-performance scale, Gridstore's HyperConverged Appliance was seen as the most cost-effective solution providing high performance and great value.



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EXECUTIVE SUMMARY

Gridstore RX-4 HyperConverged Appliance is a single system that combines high performance x86 compute infrastructure with low latency, all-flash storage nodes. The system comes preinstalled with the required management and control software. Offered as an “integrated” package, the HyperConverged Appliance aims at accelerating time to value, achieving scalable performance, and reducing the overall datacenter costs of ownership.

This whitepaper is aimed at organizations’ IT decision makers looking to compare and contrast private cloud system offerings from leading technology vendors. Full-rack systems from VCE, HP, IBM, and Gridstore were reviewed and compared. Except Gridstore that uses Microsoft Hyper-V for virtualization, all remaining vendors were considered running a VMware hypervisor. Price-to-performance¹ comparisons have been collected and summarized across each vendor based on a price-per-Virtual Machine (VM) metric. Three additional price-to-performance metrics – price-per-system core, price-per-system memory, and price-per-usable storage; and two other VM workload performance metrics – available memory-per-core and available storage-per-core were also examined.

In Figure 1 results closer to the center show lower price-per-specification. The results show that Gridstore RX-4 HyperConverged Appliance has the lowest price-per-VM for a standard VM profile. The highly dense, all-flash RX-4 full rack is also better than the competition in rest of the price-performance metrics, thus demonstrating that it is a high-performing and economical private cloud solution offering.

This comparison is based on publicly available list price and specification metrics. Individual vendors offer different discounts and volume price breaks, so the actual results may be lower than the ones listed here.



Figure 1: Price-to-Performance Ratios across Multiple Converged Infrastructure Systems (Costs in U.S. dollars, in Thousands)

¹ Refers to the five-year net present value (NPV) of system purchase price. This includes upfront costs of hardware, software licenses, installation, and prepaid maintenance and support; and recurring costs of maintenance and support agreements. All prices are list prices and exclude any vendor and volume specific discounts.

INTRODUCTION

Situation

Traditional, do-it-yourself virtualization solutions require considerable amounts of time and effort in design and provisioning of basic cloud services, scaling out infrastructure, and integrating various non-standard hardware and software components. Until recently, customers sought converged infrastructure solutions that promised to provide a consistent cloud experience supporting business agility and reducing infrastructure and management costs.

The converged infrastructure market features multiple compute, shared storage, and network component vendors that package these capabilities within a “same box” OEM solution. However, these solutions rely on legacy cluster storage architecture, which are often associated with large CapEx costs in procuring the storage infrastructure; and even larger OpEx costs in planning, provisioning, and managing them.

Solution

With constant budgetary pressure on the enterprises to lower their IT costs, it is key that they look for alternatives that can deliver performance at a lower price. Hyper-converged computing environment that integrates low-cost and commodity compute and storage resources into a single node – each of which is a building block to a larger high-performance cluster – thereby eliminating the need of expensive and high-latency network based storage. The infrastructure is 100% software defined and delivers all performance, management, automation, monitoring, and self-healing capabilities via an intelligent controller VM that resides within the same block. Finally, the environment is 100% distributed, i.e., the VMs, user data, and operations are spread across the various nodes that make up the cluster.

Gridstore RX-4 HyperConverged Appliance

Gridstore RX-4 HyperConverged Appliance is a single system that combines high performance x86 compute infrastructure with low latency, all-flash storage nodes. The private cloud solution, based on Microsoft’s Fast Track Reference Architecture, is designed to deliver greater performance and streamline IT costs compared to traditional and converged appliance deployments.

The RX-4 full rack provides a highly dense private cloud environment that supports 16 FCN-90 blocks (each block is 4 nodes). Each block is a pre-configured, pre-optimized, and scalable unit, which includes:

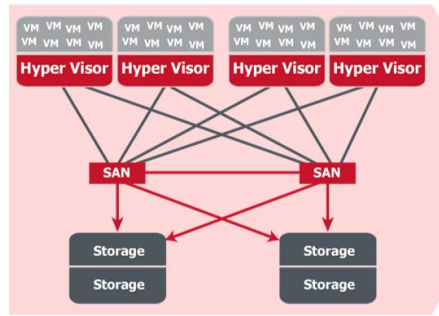
- Hardware components required to run the system, including the rack, consolidated compute, SAN, and storage node, and networking devices that support the organization’s virtualization workloads; and
- Software required to run the system, including server operating system, virtualization hypervisor, and management software used for monitoring and provisioning of datacenter workloads.

Private Cloud Solutions Included:

- Gridstore RX-4 HyperConverged Appliance with Microsoft Private Cloudⁱ (Microsoft Private Cloud Fast Track Reference Architecture)*
- VCE Vblock System 340ⁱⁱ
- HP ConvergedSystem 700 (CS700)ⁱⁱⁱ with VMware
- IBM PureFlex System^{iv} (with Storwize V7000^v) with VMware

* The Microsoft Fast Track Reference Architecture (FTRA) is a joint effort between Microsoft and its hardware partners to deliver a pre-integrated and consistent private cloud solution. The Microsoft validated configurations increase agility and minimize complexity and risk associated with private cloud deployments. For more information, visit: <http://bit.ly/1As4bXe>.

Eliminate layers of cost and complexity



Management Points, Bottlenecks and Complexity Grow with Scale

All-Flash HyperConverged.



Consolidates
Compute, SAN, Storage .

Figure 2: Simplification of converged infrastructure with Gridstore

Organizations can simply follow the reference architecture design and guidance documents available from Gridstore – to build out a private cloud infrastructure that meets their desired scale and size. The pre-validated designs removes much of the guess-work and planning associated with legacy or build-it-yourself solutions that could take many months; and provides organizations an opportunity to get up and running quickly with their cloud initiatives, lower their IT costs, and deploy their revenue generating applications and services much faster.

By-and-large, purchase of the system is also a simple process that involves buying a fixed set of software and hardware. However with a pre-packaged model, it has also become harder to compare and contrast similar solutions. In this study commissioned by Gridstore, several converged infrastructure systems, as listed in the sidebar, have been reviewed, summarized, and compared. Each vendor provides via its Website datasheets, architecture guidelines, and bill-of-material (BOM) lists that have been used as the primary source for specification data (such as cores, memory, storage, etc.). List pricing and other annual costs details are cited specifically, and are also taken from public sources. Full rack pricing and specifications were used for each vendor to ensure consistent comparison.

SYSTEM COSTS

The system costs over a five-year period were calculated to include upfront investments in hardware, software licenses, deployment, maintenance and support; and recurring annual investments in appliance maintenance and support agreements. The summary of the total price for converged infrastructure systems is presented as a five year NPV, which assumes a discount rate of 10%.

NOTE: This comparison is based on the list price and publicly available price and specification metrics. Each unique customer discount situation will be different, and more information (and customization) is likely available from each vendor so the comparison may be different than the one using only list prices and specifications. All prices are listed in U.S. dollars and rounded to the nearest hundreds for sub-categories and nearest thousands for totals.

Costs	Gridstore RX-4	VCE Vblock System 340	HP CS700 (with VMware)	IBM PureFlex (with VMware)
System Nodes² (and Cores)	64 (1,536)	18 (416)	18 (432)	42 (992)
Appliance	\$3,124,000	\$1,014,800	\$826,200	\$2,189,000
Deployment	\$75,000	\$89,000	\$72,000	\$75,000
Maintenance/Subscription	\$261,000	\$116,000	\$104,600	\$247,200
Support		\$34,000	\$43,400	\$57,600
Total Y1 (Upfront)	\$3,460,000	\$1,254,000	\$1,046,000	\$2,569,000
Total Y2- Y5 (Annual)	\$261,000	\$150,000	\$148,000	\$305,000
5 Year NPV of Costs*	\$4,287,000	\$1,729,000	\$1,515,000	\$3,536,000
Price-per-VM**	\$1,820	\$5,400	\$10,900	\$6,390

* Calculated **based on list prices** over 5 years. Negotiated prices after vendor discounts will likely be lower.

** Total supported VMs was limited either by capacity cores, memory, or usable storage available for hosting a standard VM with 2 CPUs, 4 GB RAM, and 250GB storage space. See Price per VM section for more details.

Table 1: Costs summary for Converged Infrastructure Systems (Costs in U.S. dollars)

Appliance

The total price of each full rack appliance is based on publicly-available information directly from the vendor price lists or pricing tools, from a reseller that has listed vendor list pricing, or if necessary from news or blog articles that have published price estimates. Total retail price for each appliance, along with the pricing source, is listed below.

- **Gridstore's** pricing of U.S. \$3,124,000 is the total system pricing (hardware and software) based on a full rack RX-4 Appliance with 64 system nodes. Although the total RX-4 Appliance price is higher compared to other vendor appliances, it should be noted that RX-4 is a highly dense environment with 1,536 system cores. The RX-4 supports 4x - 17x more VMs for a full rack configuration compared to other vendor appliances. Refer section titled "Scalable Architecture" for Gridstore's scale capabilities. The pricing was furnished by the vendor for the purpose of this whitepaper.
- **VCE** provides an architecture overview^{vi} document for the Vblock system 340 that lists the recommended BOM for the full rack appliance with 18 system nodes (432 cores). Vblock System 340 contains server and networking hardware from Cisco,^{vii} storage hardware from EMC,^{viii} and virtualization software from VMware.^{ix x} Additional software add-ons from Cisco^{xi} (for network switches), EMC (for storage solution), and Microsoft^{xii} (OS and database) were also considered as recommended in the architecture guidelines. The hardware and software costs from the sources cited above are U.S. \$589,600 and U.S. \$425,200 respectively for the 18-node full rack appliance.
- **HP** provides a quick specsⁱⁱⁱ document and a technical system guide^{xiii} that lists the BOM for a full rack HP CS700 with 18 system nodes (432 cores). Hardware prices were derived from HP's configuration and pricing tool on their online store and

² Includes capacity and management nodes.

totals to U.S. \$515,200 for the base + three expansion kit full rack.^{xiv} Software pricing includes components from HP,^{xv} VMware (for virtualization), and Microsoft (OS and database) totaling to U.S. \$311,000.

- **IBM** PureFlex and Storwize V7000 redbooks^{xvi xvii} were used to determine the complete BOM for PureFlex system full rack, which has 42 system nodes (992 cores). The hardware price was determined by building out the required configuration on IBM's online store^{xviii} and obtaining some individual hardware and IBM software component prices at the system options store.^{xix} The hardware list price for the a three-chassis full rack with x240 compute nodes comes up to U.S. \$ 1,459,700. The software costs also included VMware (for virtualization) and Microsoft (OS and database) licenses, totaling to U.S. \$729,300.

Deployment

The deployment costs are one-time professional services costs related to system and software installation and start up.

NOTE: This is only part of the overall deployment cost considerations. Customers should carefully evaluate overall project management, workload migration, and testing costs, which are highly variable and may not be similar across platforms.

- **Gridstore's** cost of U.S. \$75,000 includes the costs of onsite deployment services.³
- **VCE** offers Deployment and Implementation Services, with a list price of U.S. \$89,000 for the Vblock System 340.
- **HP's** installation and deployment costs were obtained from an Enterprise Strategy Group (ESG) whitepaper, which listed these at U.S. \$72,000.^{xx}
- **IBM's** installation and deployment costs were similarly obtained from a Forrester whitepaper, which had these costs at U.S. \$50,000 for a 2 chassis PureFlex system.
^{xxi} A linear scaling was assumed to estimate the 3 chassis full rack cost of U.S. \$75,000.

Maintenance and Support

Most vendors require customers to pay an annual hardware and software support fee as a percentage of the initial acquisition costs. The table below summarizes these costs along with the source and assumptions:

- **Gridstore** identified a combined annual maintenance and support cost of U.S. \$261,000 for the full rack RX-4 Appliance.³
- **VCE's** annual software maintenance costs of U.S. \$116,000 includes VMware Support and Subscription (SnS),^{ix} x Microsoft SA,^{xii} and additional EMC software support costs, which ranges 7% to 23% of the list price.^{viii} Since VCE's premier support pricing was not available publicly, we estimated the annual support price

³ Vendor furnished pricing data for the whitepaper.

by including Cisco's SmartNet 24x7x4^{xxii} and EMC's Optional Maintenance Costs^{viii} for hardware. These support levels are fairly representative of Microsoft's PMC support; and at U.S. \$34,000, estimated to be lower than VCE's premier support agreement.

- **HP's** annual software maintenance costs of U.S. \$ 104,600 includes HP software support at approximately 21% of the list price,^{xiv} VMware SnS,^{ix x} and Microsoft SA.^{xii} HP offers a 24x7x4 Proactive Care Advanced hardware support service that is representative of Microsoft's PMC support level. The total hardware support price of U.S. \$43,400 was calculated using the HP Care Pack Central website.^{xxiii}
- **IBM's** annual software maintenance costs at 25% of the list price,^{xxiv} added to the VMware SnS^{ix x} and Microsoft SA^{xii} totals to U.S. \$247,200. IBM 24x7 annual support with remote technical assistance for the three-chassis, 42-server full rack appliance was priced at U.S. \$57,600.^{xviii}

PRICE-TO-PERFORMANCE COMPARISONS

The Table 2 below summarizes key specifications of the converged infrastructure systems as obtained from their spec sheets, along with the five-year cost. Refer to Appendix C for more detailed specifications.

As seen in the table, the systems have varying numbers of cores, memory, and user storage, so simply looking at total price is not a reasonable comparison. To provide a more accurate comparison, scaled price-to-performance and VM performance metrics have been calculated and presented.

Specifications	Gridstore RX-4	VCE Vblock System 340	HP CS700 (with VMware)	IBM PureFlex (with VMware)
Total System Cores⁴	1,536	416	432	992
Total System Memory (GB)⁴	16,384	1,792	4,608	10,528
RAW Storage (TB)⁵	925	180	43	173
Usable Space Estimate (%)⁶	66%	80%	80%	80%
Usable Storage (TB)	611	144	35	138
5 Year NPV of Costs*	\$4,287,000	\$1,729,000	\$1,515,000	\$3,536,000
Price-per-VM**	\$1,820	\$5,400	\$10,900	\$6,390

* Calculated **based on list prices** over 5 years. Negotiated prices after vendor discounts will likely be lower.

** Total supported VMs was limited either by capacity cores, memory, or usable storage available for hosting a standard VM with 2 CPUs, 4 GB RAM, and 250GB storage space. See Price per VM section for more details.

Table 2: Converged Infrastructure Systems Specifications and 5 Year NPV of Costs (Costs in U.S. dollars)

Performance Metrics:

- **Price-per-VM** as a key performance metric that shows the price for hosting a single standard VM across each vendor appliance. A lower value for a vendor indicates

⁴ Includes compute and management nodes.

⁵ Includes storage from storage nodes / racks only. Does not count the disk space available within system nodes.

⁶ Discounted for RAID and fault tolerance.

that, at the same available budget, a customer can set up a much denser environment hosting larger number of VM workloads compared to other vendors.

- **Price-per-system core** as a measure of system performance at a given price. More cores provide capacity for more concurrent compute tasks. Lower price indicates better system performance at a given price.
- **Price-per-system memory** as a second measure of system performance. Since memory is able to store information in a quickly-accessible place, more memory means more information can be stored without having to write to a disk. Again, lower price indicates better system performance at a given price.
- **Price-per-usable storage space** as a storage value approximation that can help provide more comparison details when the amount of usable space is not the same across all vendor appliances. Lower price for a vendor indicates availability of more space for VM workloads compared to rest of the vendors, at the same price point.
- **Available memory-per-core** and **available storage-per-core** as VM performance indicators. A larger number indicates more system memory and storage space is available for a given VM profile.

Price per VM

For calculating the price-per-VM, we started off by defining the VM profile. We used the following VM profile as a “standard” for the metric calculations.

CPU	RAM (GB)	Disk Size (GB)
2	4	250

Table 3: Standard VM Profile

Most datacenter virtual environments are oversubscribed and stacked, meaning the number of VMs multiplied by the available CPU cores is greater than the total CPU GHz purchased. This is required to make sure that the datacenter resources are not under-utilized. There are varying arguments on what should be considered an acceptable oversubscription factor; estimates point 1:1 to 3:1 as an acceptable range without a visible loss in performance. We considered a conservative 1.2:1 or 20% oversubscription.

Given hosters and cloud datacenters advertise vCPUs at 1GHz, we also considered an additional stacking factor of 2.6 for our supported VM calculations, which was consistent with the 2.6GHz clock speed for E5-2690v3 processor used in the Gridstore HyperConverged Appliance.

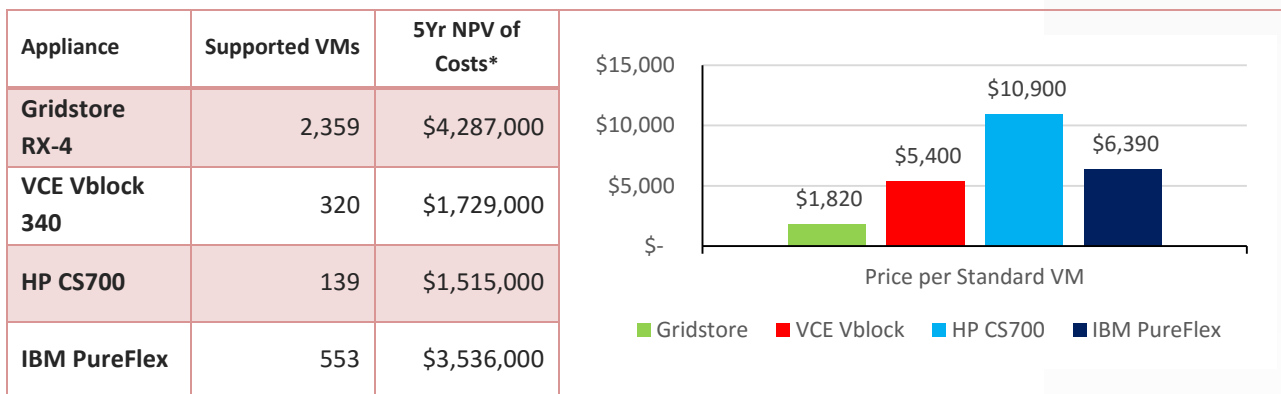
Finally, no memory oversubscription was considered as this is seen to adversely affect VM performance.

Supported VM Calculations:

Appliance	Capacity Cores ⁷	Capacity RAM (GB) ^{7 8}	Usable Disk Space (TB)	Total Supported VMs
Gridstore RX-4	1,512	15,120	611	2,359
VCE Vblock 340	384	1,280	144	320
HP CS700	384	3,840	35	139
IBM PureFlex	984	9,840	138	553

Table 4: Supported VM Calculations for Each Appliance (Costs in U.S. dollars)

Total number of supported VMs was limited either by total capacity cores, memory, or usable storage available for hosting the standard VM.



* Calculated based on list prices over 5 years. Negotiated prices after vendor discounts will likely be lower.

Figure 3: Price per VM Comparison for Each Appliance (Costs in U.S. dollars)

As seen in Figure 3, Gridstore has the lowest (3x to 6x) price-per-VM metric. HP and IBM were limited by their low available storage, although the recommended and maximum supported disk size as per the architecture guidance was selected for each vendor.

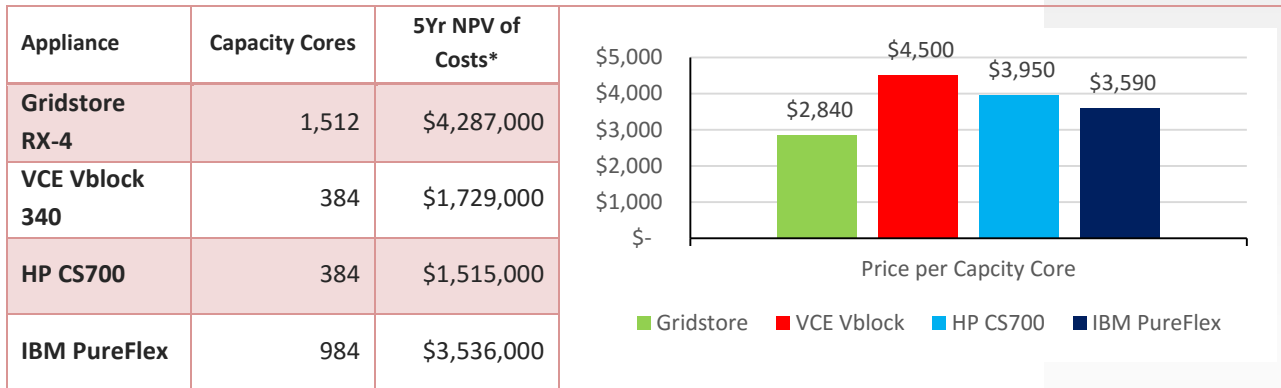
Price per Core

Appliance processors and cores provide the engines for running the VM workloads and associated management functionality. With more cores virtual machines run more efficiently; meaning they can handle larger workloads, while still providing high performance results. More is better, but with appliances that can scale by adding more nodes, chassis, or racks, even more important is the price per system core. Note that the number of cores is not directly correlated with the price – some licenses are not required for every core, but price-per-core provides a view into the performance of each appliance as a factor of total costs.

When viewed in relation to the price for full rack appliances, Gridstore was leading the pack at U.S. \$2,840 per capacity core. VCE was the most expensive at U.S. \$4,500 per capacity core.

⁷ All appliances use a portion of their capacity nodes on the rack as management servers.

⁸ A further 16GB of RAM was reduced per capacity node to accommodate OS partition and hypervisor functions.

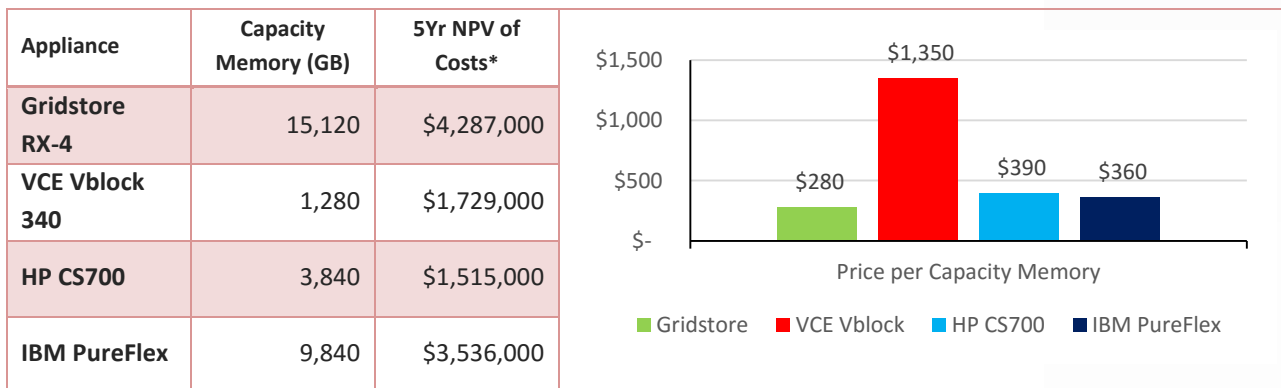


* Calculated **based on list prices** over 5 years. Negotiated prices after vendor discounts will likely be lower.

Price per Memory

Like cores, the amount of memory included in a full rack appliance is a significant indicator of potential performance. Large amounts of memory allow for faster operation of workloads by keeping more information to be processed in memory, instead of having to make read/write calls to the hard drive. Memory is much more expensive than disk drives (for equal units of storage), so in addition to the storage metric considered below, it is important to include price-per-memory ratio comparison as well. As seen in Figure 5, Gridstore fared better than the competition and was almost 4.8 times lower compared to VCE.

Figure 4: Price per Capacity Core Comparison for Each Appliance (Costs in U.S. dollars)



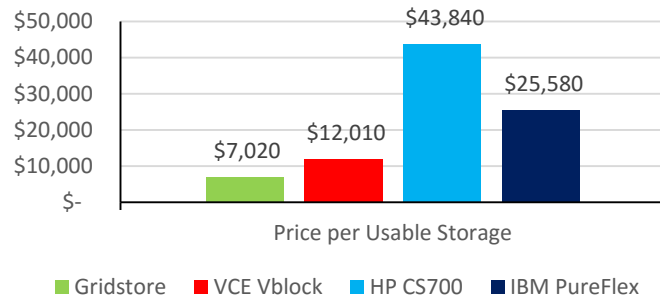
* Calculated **based on list prices** over 5 years. Negotiated prices after vendor discounts will likely be lower.

Price per Usable Storage

Usable storage for a full rack appliance is included to provide perspective of total storage provided for VM workloads after discounting for RAID and fault tolerance. For each vendor, we selected the recommended and maximum supported disk size as per the architecture guidance. On the price-per-usable storage metric, while Gridstore led the pack, HP and IBM appliances performed poorly owing to their low available storage space.

Figure 5: Price per Capacity Memory (GB) Comparison for Each Appliance (Costs in U.S. dollars)

Appliance	Usable Storage (TB)	5Yr NPV of Costs*
Gridstore RX-4	611	\$4,287,000
VCE Vblock 340	144	\$1,729,000
HP CS700	35	\$1,515,000
IBM PureFlex	138	\$3,536,000



* Calculated based on list prices over 5 years. Negotiated prices after vendor discounts will likely be lower.

Figure 6: Price per Usable Storage (TB) Comparison for Each Appliance (Costs in U.S. dollars)

Other VM Performance Indicators

Low memory allocation is one of the most common causes of performance issues in VMs. Techniques such as memory compression and memory swapping can be used to get “more” out of the available RAM, but when overcommitted, these often lead to a severe degradation of VM performance. Similarly, storage oversubscription using techniques such as thin provisioning can often improve organization’s storage capacity utilization. However, if not managed properly VMs may be forced to believe there is space available when it actually isn’t, resulting in serious data losses.

The safest approach therefore, is to have enough memory and storage space in the system for supporting the VMs reliably. Thus, available memory-per-core and available storage-per-core are key VM performance indicators. Figure 7 and 8 show that Gridstore RX-4 Appliance is either comparable or better than the rest of the vendor appliances for both these metrics. Also, Gridstore is seen to have 3x more memory per core compared to VCE’s Vblock System 340.

Appliance	Capacity Cores	Capacity Memory (GB)
Gridstore RX-4	1,512	15,120
VCE Vblock 340	384	1,280
HP CS700	384	3,840
IBM PureFlex	984	9,840

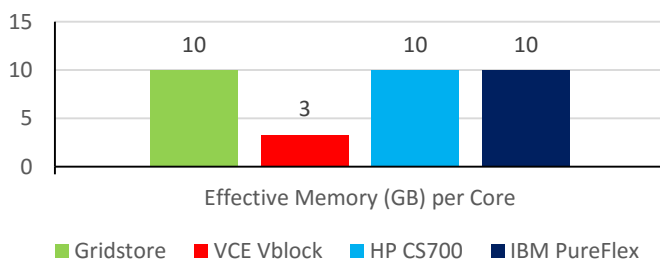


Figure 7: Memory (GB) per Capacity Core Comparison for Each Appliance

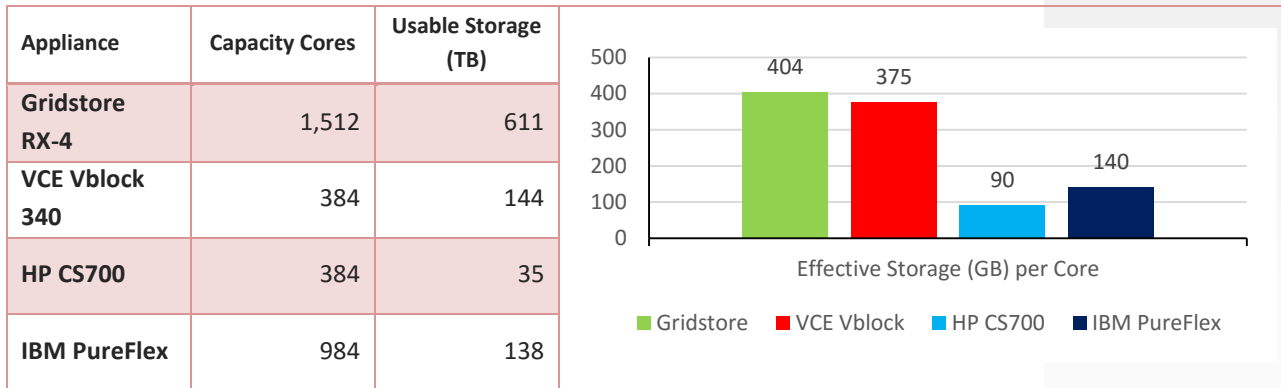


Figure 8: Usable Storage (TB) per Capacity Core Comparison for Each Appliance

SCALABLE ARCHITECTURE

The calculated price-performance metrics clearly demonstrate that the Gridstore RX-4 is a power packed full rack hyper-converged appliance that can meet the needs of any enterprise, while providing greater economies of scale compared to other vendor converged appliances. However, customers with smaller deployments are not required to purchase the full rack upfront. Designed using Microsoft's Fast Track Reference Architecture, the Gridstore Appliance can be scaled incrementally as per the customer requirements, starting with a single FCN-90⁹ block with only 3 nodes to as many as 64 blocks with 256 nodes. For approximately one-fourth the RX-4 Appliance price, a four block RX-1 (16 node) solution provides 384 system cores, 4TB of memory, and 153TB of usable storage space. Customers using RX-1 can achieve greater VM density than other vendor full-rack appliances – and that too at a 75% smaller foot print.

FCN-90 Single Block (4 nodes)

RX-1 (4 blocks/16 nodes)

RX-4 (16 blocks/64 nodes)

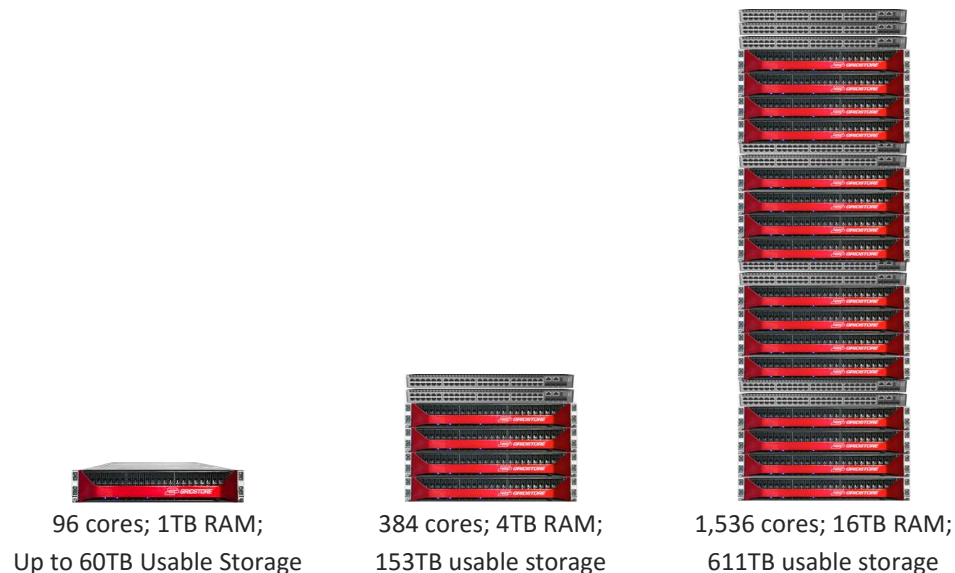


Figure 9: Scaling Gridstore all-flash HyperConverged Appliance

⁹ A single FCN-90 block supports up to 4 compute + storage nodes. A minimum of 3 nodes are required to start, after which the appliance can be scaled linearly by adding individual nodes.

CONCLUSION: GRIDSTORE OFFERS BREAKTHROUGH DENSITY, ECONOMICS, AND PRICE-PERFORMANCE

The Gridstore HyperConverged Solution provides a highly dense environment that supports significantly more VMs (4x to 17x) in a single 42U full rack solution compared to competing vendor converged appliances. Owing to such a dense environment, IT departments can expect to simplify administration and reduce the costs of infrastructure being managed.

The all-flash hyper-converged RX-4 solution produces breakthrough economics, both in terms of a competitively priced solution compared to the other vendor options, and also the best price-to-performance on key metrics such as Price-per-VM. It also offers the best memory-per-core and storage-per-core metrics in a single rack versus the other named vendor alternatives, enabling customers to run intensive and mixed workloads.

APPENDIX

A: Methodology

In a study commissioned by Gridstore, similar converged infrastructure systems from four leading vendors have been reviewed, summarized, and compared, based on publicly-available price and specification information. The four vendors compared in this study were:

- Gridstore
- VCE
- HP
- IBM

Full rack appliances for each vendor were compared, to ensure standard comparisons across large-capacity appliances. Summary metrics and total price were compared. Price-per-VM is used as a price/value approximation that can help provide more accurate comparison details when the amount of cores, memory, and usable space is not the same across all appliances.

Comparisons are based on the list price and publicly available cost and specification metrics. In addition to the appliance price, which is only part of the cost considerations, the analysis included installation, maintenance, and support costs.

Each discussion with vendors and their customer discount situation will be different, and more information (and customization) is likely available from the vendors. Individual results may thus be lower than the ones listed here. Customer should carefully evaluate deployment, migration, and on-going management costs specific to their solution requirements before making a decision.

B: About Value Prism Consulting

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C: Converged Infrastructure System Specifications

Vendor:	Gridstore	VCE	HP	IBM
Product:	Gridstore Rx-4	VCE Vblock 300 Series	HP CS 700 with VMware	IBM PureFlex System x240 with VMware
Unit Considered:	Full Rack	Vblock 340 Full Rack	Full Rack with Base + 3 Expansion Kits	3-chassis, with Storwize V7000
Hypervisor:	Microsoft Hyper-V	VMware vSphere	VMware vSphere	VMware vSphere
Management:	System Center, Microsoft Azure Pack, Grid OS3.5	VMware vCenter, Other EMC and Cisco products	VMware vCenter, Other HP products	VMware vCenter, IBM Flex System Manager
Capacity Nodes:	63	16	16	41
Processors:	126	32	32	82
Cores:	1,512	384	384	984
Memory (GB):	15,120	1,280	3,840	9,840
Clock Speed (GHz):	2.6	2.7	2.7	2.7
Management Nodes:	1	2	2	1
Processors:	2	4	4	1
Cores:	24	32	48	8
Memory (GB):	256	256	512	32
Clock Speed (GHz):	2.6	2.6	2.4	2
Storage Nodes:	NA	1	1	2
Processors:	NA	2	1	2
Cores:	NA	8	2	16
Memory (GB):	NA	N/A	N/A	64
Clock Speed (GHz):	NA	1.8	1.8	1.9
Storage Units:	16	4	6	4
Number of HDs:	24	60	144	96
HDD Size (TB):	Mix of 960GB and 3,860GB	3	0.3	1.8
RAW Storage (TB):	925	180	43.2	172.8
Usable space	66%	80%	80%	80%
Usable Storage (TB):	611	144	34.56	138.24

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