



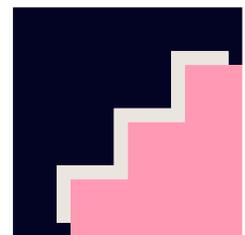
Make Kubernetes containers on Dell EMC PowerEdge R740xd servers easier to manage with VMware Tanzu

Running VMware Tanzu on a VMware vSphere 7.0 Update 1 environment with Dell EMC PowerEdge servers provided centralized container management features at reasonable cost

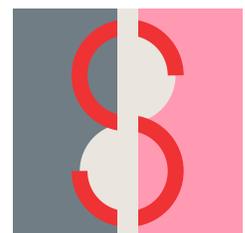
The growing use of containerized applications in business has been significant over the past few years. Organizations seek to modernize their applications by moving from monolithic legacy apps to a common Kubernetes (K8s) framework, while also facing the common challenges that come with change, such as choosing the right tool for managing this new paradigm, friction between IT and DevOps throughout the deployment and day 2 operations, and cost. Organizations can achieve this modular cloud-native approach by combining two evolved products in the software and hardware space—Dell EMC™ PowerEdge™ and VMware vSphere—with VMware Tanzu. VMware® Tanzu™ on VMware vSphere® hosts can streamline K8s deployment with a wizard-based approach and a single configuration point with automatic cluster deployment, and it can provide rich, ongoing management in an environment that IT is already familiar with. In turn, Dell EMC PowerEdge R740xd servers support vSphere hosts with strong CPU, RAM, and storage resources, which could help reduce data center sprawl.

In the Principled Technologies data center, we created an environment based on three Dell EMC PowerEdge R740xd servers running VMware vSphere 7.0 Update 1 and VMware Tanzu to show that the latest release of vSphere offers support for this container management solution. This report explores some of the benefits that the combination of Tanzu, vSphere, and PowerEdge R740xd servers can bring to K8s deployments and describes our experience deploying Tanzu to the existing environment. Adding Tanzu required seven tasks, a straightforward path that could allow admins to set up a future ready K8s solution quickly and easily so DevOps teams can spend more time creating containers and developing apps.

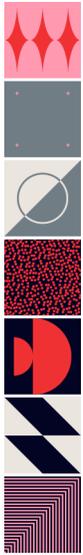
We also found that adding Tanzu to a vSphere 7.0 Update 1 environment of PowerEdge R740xd servers would require the addition of only the Tanzu Basic Edition license, making it a viable choice for organizations seeking to implement centralized containerized workloads with minimal acquisition costs.



Only 7 tasks
to add Tanzu to an
existing vSphere
environment



**Add just one
license** to get
up and running
with Tanzu



App modernization: A closer look

App modernization has become a more common term recently with the rapid growth in use of nature of containers and orchestration. But what benefits does it bring? And what exactly is it? To answer these questions, we must look backward first.

The past three decades have brought the evolution and maturity of personal computing, the birth and explosive growth of the world wide web, a mobile computing revolution, the innovation and adoption of the Internet of Things, an ever-increasing amount of data, and a monumental shift to the cloud for organizations and end users alike. Backend data center computing models have shifted over that time from a monolithic, static client-server application and infrastructure model to a widely used virtualization paradigm, where virtual machines (VMs) hosted the interconnected middleware and backend database components of application stacks. Application designs grew more interdependent and compartmentalized, creating efficiency issues, VM sprawl, and management challenges—not to mention the challenge of shadow IT and integrating with the public cloud.

Containers are compartmentalized, and therefore well suited for application modularity. They break down components of applications so admins can easily recreate, move, and deploy them almost instantly. Using containers, for example, IT staff can deploy application stack components such as web or database servers in seconds, in contrast to the monolithic model that required an infrastructure request and waiting days for another team to respond.

Organizations that modernize their monolithic, legacy applications with containers could potentially take advantage of the features—portability, speed of deployment, and more—to improve business operations, expand the organization’s user base, and increase customer satisfaction.

About Dell EMC PowerEdge R740xd servers

The Dell EMC PowerEdge R740xd is a two-socket rack server built on 2nd Generation Intel® Xeon® Scalable processors that fits into just 2U of rack space. With extra drive slots for storage scalability, the PowerEdge R740xd supports up to 24 NVMe drives, 32 2.5" drives—or 18 3.5" drives—as well as Intel Optane™ PMem. The PowerEdge R740xd supports demanding workloads including HPC, software-defined storage, and Big Data. To learn more about the advantages that the Dell EMC PowerEdge R740xd offers, visit <https://www.dell.com/en-us/work/shop/povw/poweredge-r740xd>.



How Kubernetes and VMware Tanzu can enhance app modernization

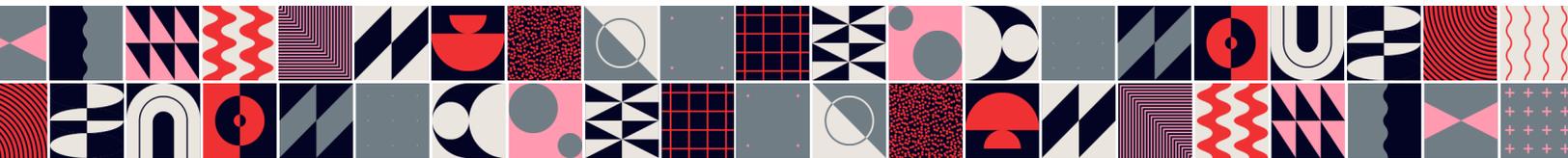
As we discussed in the previous section, organizations may choose containers, like those created and managed with K8s solutions, to help modernize their applications because of the flexibility these solutions offer. Developers and IT admins can select the right application framework, languages, monitoring and logging tools, and other necessary resources for their applications.

However, app modernization is more than just moving to containers. It is an ongoing, multi-team process that encompasses orchestration, security, and management. An app modernization effort should preferably use tools that your staff already know, so you can lower training costs. For organizations that already use VMware software and tools, the learning curve could be minimal. A VMware Tanzu K8s solution can deliver orchestration and manageability to the containerization effort using vSphere, a virtualization platform with over a decade of market exposure. It lets you manage clusters of containers, which can help developers and IT teams scale and simplify container creation to help meet those modernization challenges on software and hardware platforms that are already familiar to them.

IT staff can install VMware Tanzu on existing on-premises servers, allowing DevOps teams to modernize applications with K8s on-premises, using future-ready resources before deploying K8s containers and applications to a production cloud. Without Tanzu, IT teams might need specialized Linux expertise to install K8s and configure nodes manually.

According to the VMware Tanzu solution brief, “VMware Tanzu addresses the Day 1 and Day 2 Kubernetes operations burden with a complete, easy-to-upgrade Kubernetes runtime with pre-integrated and validated components. This enables you to run the same K8s across data center, public cloud and edge for a consistent, secure experience for all development teams.”¹

To learn more about how VMware Tanzu streamlines Kubernetes management, visit <https://tanzu.vmware.com/tanzu>.



Getting a future-ready infrastructure of Kubernetes, VMware Tanzu, and Dell EMC PowerEdge R740xd servers

Modernizing applications requires constant dedication to meeting the challenges of not just today's disruptive technologies but those of the future as well. A Dell EMC PowerEdge R740xd server cluster could provide a solid foundation for modernizing applications because it is fully capable of running a Tanzu K8s solution. Building your VMware Tanzu environment with new PowerEdge R740xd servers gives your K8s environment a known and stable base to grow from, one that promotes the innovation your organization needs to grow.

More on Tanzu architecture

VMware vSphere with Tanzu is VMware's distribution of the open-source Kubernetes container software. It consists of several software layers and groups of virtual resources that run on top of traditional VMware architecture. Figure 1 shows a workload platform architecture in a vSphere with Tanzu software-defined data center (SDDC).

vSphere admins can enable a vSphere cluster for managing a Tanzu workload by creating a Supervisor cluster on the vSphere cluster. This Supervisor cluster acts as a high-level control plane that allows admins to manage namespace creation, licensing, and networking integration. The Supervisor cluster runs on top of the VMware SDDC layer that consists of at least three physical servers running VMware ESXi, VMware NSX-T Data Center or vSphere networking, and shared storage.

Moving from the control plane to the workload plane where users' applications reside, vSphere with Tanzu enables the creation of Tanzu Kubernetes clusters, which are fully functional K8s clusters consisting of VMs. Within the Tanzu Kubernetes cluster are many control VMs and workload VMs. vSphere Pods, which reside in the workload VMs, are the equivalent of K8s Pods and contain groups of containers. The Tanzu Kubernetes Grid Service allows admins to provision, operate, and manage a Tanzu Kubernetes Cluster.

For vSphere Pods, VMs running inside the Supervisor cluster, and VMs running inside a Tanzu Kubernetes cluster, vSphere with Tanzu uses shared storage for persistent volumes.

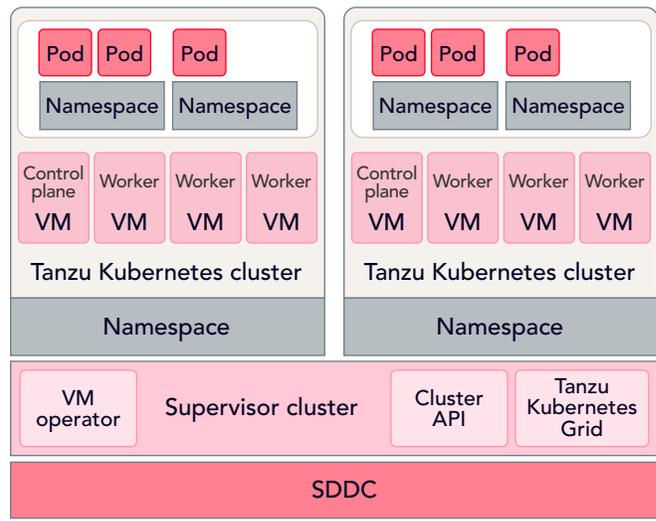


Figure 1: A diagram of a workload platform architecture in a vSphere and Tanzu SDDC. Source: Principled Technologies (adapted from VMware)².

After an admin creates the Supervisor cluster, they create a vSphere Namespace. By default, the namespace has unlimited resources within the Supervisor cluster. A vSphere administrator can set limits for CPU, memory, and storage that a Tanzu Kubernetes cluster can use within the namespace.

When provisioning a Tanzu Kubernetes cluster, users specify the VM class type for each controller and worker node for their pod. Each class type reserves a set number of resources for the VM, including CPU, memory, and storage. In addition, each class type has guaranteed and best effort options depending on use case.

After an admin creates a namespace and configures resource limits, user permissions, and storage policies, a developer can use the Tanzu Kubernetes Grid Service API to access the namespace, create Tanzu Kubernetes clusters, and run K8s workloads by using the same kubectl and YAML definition they would use with standard Kubernetes clusters.

Containerize your apps using VMware Tanzu on a Dell EMC PowerEdge R740xd cluster for reasonable costs

Technology costs can seem daunting, especially when you're acquiring new technologies and platforms. However, choosing known and proven platforms that your staff are familiar with, such as Dell EMC PowerEdge servers and VMware vSphere virtualization platform, could help to mitigate some onboarding costs.

For this report, we wanted to estimate the cost of the solution we tested, a three-node cluster of Dell EMC PowerEdge servers running a recent VMware vSphere version and VMware Tanzu. Including vSphere and Tanzu Basic gives your company a good head start on their way to app modernization, containerization, and the benefits those changes bring. Plus, vSphere and Tanzu are likely known platforms for your DevOps teams.

Using publicly available retail pricing data, we estimate that purchasing Tanzu and the three-server, six-processor solution we tested would cost approximately \$161,830 USD.³ If you already had these servers in a VMware virtualized environment, you could purchase the Tanzu Basic license for only \$17,910.⁴ In Table 1, we break down the cost of the entire solution we tested for both scenarios. The entire solution is available for purchase through Dell.

Table 1: Publicly available pricing information for our solution.

Category	Item	Cost of adding Tanzu to existing PowerEdge environment	Cost for new procurement
Hardware	PowerEdge R740 server (three-node cluster)	N/A <i>(already purchased)</i>	\$67,431.00
VMware software	VMware vSphere - CPU Edition (six CPUs)	N/A <i>(already purchased)</i>	\$86,440.20
	vSphere Tanzu Basic (six CPUs)	\$17,910.00	
Support	Next Business Day - ProSupport, Three Year Support	N/A <i>(already purchased)</i>	\$7,959.54
Upgrade & new procurement total hardware & software cost with Tanzu Basic		\$17,910.00	\$161,830.74

If you consider that members of your IT staff might know or have worked with the key technologies of this solution, supporting Tanzu and containerized apps with an investment like this could deliver solid value for your organization.

VMware

+

Tanzu

- ✔ Leverage a three-server solution
- ✔ Modernize applications with containers
- ✔ Accelerate DevOps with Tanzu Basic



Adding VMware Tanzu to a VMware vSphere 7.0 Update 1 environment running on Dell EMC PowerEdge R740xd servers

Admins can follow a clear path to deploy Tanzu to a vSphere environment. We completed seven tasks (see Figure 2), each involving multiple processes and actions. This section explains, in some technical detail, how we added Tanzu, and it offers guidance on how to prepare for the deployment.

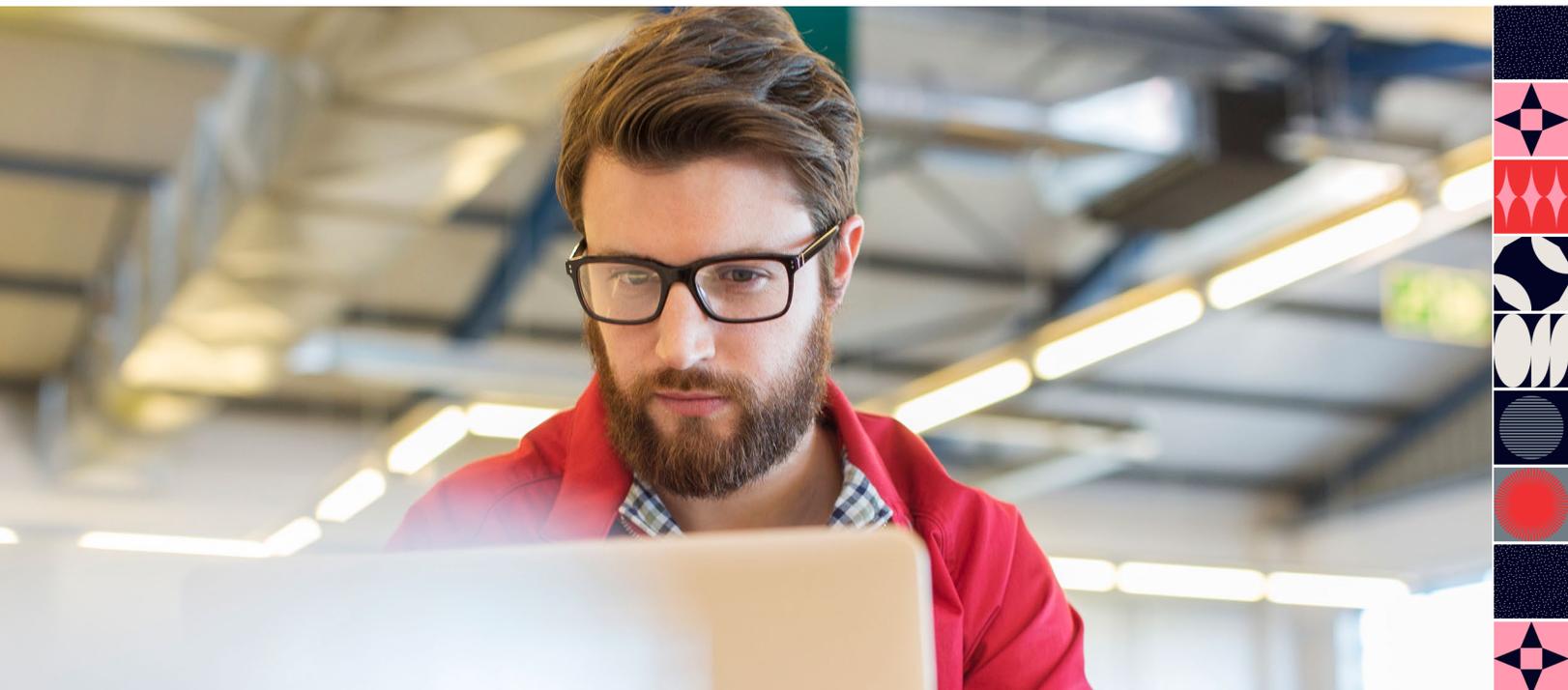
Adding Tanzu to the vSphere environment requires some planning to meet all prerequisites and configure networking for the initial deployment. Previous versions of VMware Tanzu supported only environments with VMware NSX network virtualization. However, vSphere 7.0 Update 1 supports the use of a load balancer appliance along with standard vSphere Distributed vSwitches (DvS) that could ease deployment for admins. For our deployment, we chose to use the latter approach with HAProxy, a free load balancer and proxy server for TCP- and HTTP-based applications.

See the [science behind the report](#) for details on what we did and information on how to obtain HAProxy.

Tasks required to add VMware Tanzu to a VMware vSphere 7.0 Update 1 environment on Dell EMC PowerEdge R740xd servers

- 1** Create a Distributed vSwitch and Port Group
19 steps
- 2** Create a DevOps user
6 steps
- 3** Create the content libraries
19 steps
- 4** Create storage tags and policies
18 steps
- 5** Deploy the load balancer
13 steps
- 6** Configure the workload management engine
11 steps
- 7** Define a namespace
8 steps

Figure 2: Tasks required to add VMware Tanzu to a VMware vSphere 7.0 Update 1 environment on Dell EMC PowerEdge R740xd servers. Source: Principled Technologies.



Completing prerequisites: Tasks 1 through 4

1. Creating a Distributed vSwitch and Port Group

We created our DvS with one port group dedicated for the workload network. This was the network that the Tanzu components used for communication within the K8s cluster. Our process took 19 steps, but if you already have a DvS, you can simply add the Port Group with any required virtual local area network (VLAN) tags, which could take as few as 4 steps. Also of note: The Tanzu environment required a management network to communicate with the vSphere environment, DNS, and other internet-based resources, and we used the default VM network.

2. Creating a DevOps user

For our deployment, we created a dedicated DevOps user in vSphere to access the K8s resources and assigned permissions. Environments and permissions will vary based on many factors. This process required 6 simple steps.

3. Creating the content libraries

We created the necessary content libraries (centralized repositories to help manage and distribute VMs, scripts, and other files for VMs) that vSphere used to deploy the HAProxy appliance and the Tanzu K8s images. It took us 12 steps to create and populate the HAProxy library. The Tanzu Kubernetes Grid (TKG) library, a subscribed content library, required 7 more steps.

4. Creating storage tags and policies

We created a storage tag, which allows you to create tag-based policies, and assigned it to the target storage. Our shared storage was a network file system (NFS) share accessible by all ESXi hosts in the cluster. This straightforward process required only 8 steps.

We also created a VM Storage policy utilizing the storage tag, which defined the target storage for Tanzu VM placement, in 10 steps.



Networking considerations

Planning your deployment can help you reduce or avoid networking conflicts. Before beginning the Tanzu deployment, we defined the networking for the cluster. The solution required only one additional network scope (a range of IP addresses).

Our network needed a gateway for successful deployment, and we used a network address translation (NAT) gateway.

The HAProxy deployment refers to the network labels and addresses differently than the VMware Workload Management configuration wizard. Without planning, IT staff may not understand the networking needs for adding Tanzu to a vSphere environment. As you're planning the networking for your solution, you might need the following addresses:

- **The HAProxy management address –**
An address on the management network used to access the HAProxy API
- **The HAProxy workload address –**
An address on the workload network for internal communication with the Tanzu components; must be outside the ranges of other addresses
- **Load balancer/virtual server addresses –**
Addresses on the workload network to provide load balancing services to the Tanzu deployment; you provide these addresses to the HAProxy wizard in CIDR format; they must be bindable by the HAProxy and outside the ranges of other addresses, especially the gateway address
- **Workload Management addresses –**
Addresses on the management network or used by the Control Plane VMs that manage the namespaces; the environment requires five sequential addresses
- **Workload Network addresses –**
Addresses used within the Tanzu environment for workload deployment and internal communication with the management VMs; input as an IP range

Note: Once configured, the HAProxy will respond to the HAProxy management and workload addresses as well as the load balancer/virtual server addresses, regardless of whether they're being used. You provide these addresses again in explicit format during workload management configuration.

Table 2 shows our networking configurations. You can simply replace our network addresses, labels, and VLANs with your own.

Table 2: Networking information for adding VMware Tanzu to our existing VMware vSphere environment on three Dell EMC PowerEdge R740xd servers.

Purpose	Address(es)	Network	VLAN
HAProxy Management	10.206.201.200/16	VM network	206
HAProxy Workload	192.168.1.2/24	Workload network	11
Load Balancer/Virtual Servers	192.168.1.240/29 (192.168.1.240 – 192.168.1.247)	Workload network	11
Workload Management	10.206.201.201 – 10.206.201.205	VM network	206
Workload Network	192.168.1.64/26 (192.168.1.65 – 192.168.1.126)	Workload network	11

Deploying the load balancer: Task 5

5. Deploying the load balancer

Once we had identified all the network addresses, we deployed HAProxy from the content library. We mapped our network addressing in advance, requiring only 13 steps and about 10 minutes. Upon completion, we powered on HAProxy and connected to <https://10.206.201.200:5556/v2> via a web browser, which provided a list of the HAProxy services' statuses through the API.

Configuring Tanzu: Tasks 6 & 7

6. Deploying the workload management engine

Configuring the workload management engine required 11 steps. In this task, we deployed and reconfigured control plane VMs for clustering. Invalid network information error messages in the vSphere task manager might self-correct.

7. Defining a namespace

Once we successfully configured the Tanzu workload management engine, we needed to configure a namespace. This was a quick task of 8 steps that included defining a namespace and then assigning it resources, such as storage, permissions, and content libraries. After completing that task, our developers could connect to the environment and deploy container workloads.

We used a configuration wizard to complete the Tanzu deployment tasks. Deploying with a configuration wizard meant there were no config files to alter or firewalls to disable or work around. The configuration wizard can help simplify and expedite deployment for your admins and deliver a functional Tanzu cluster quickly.

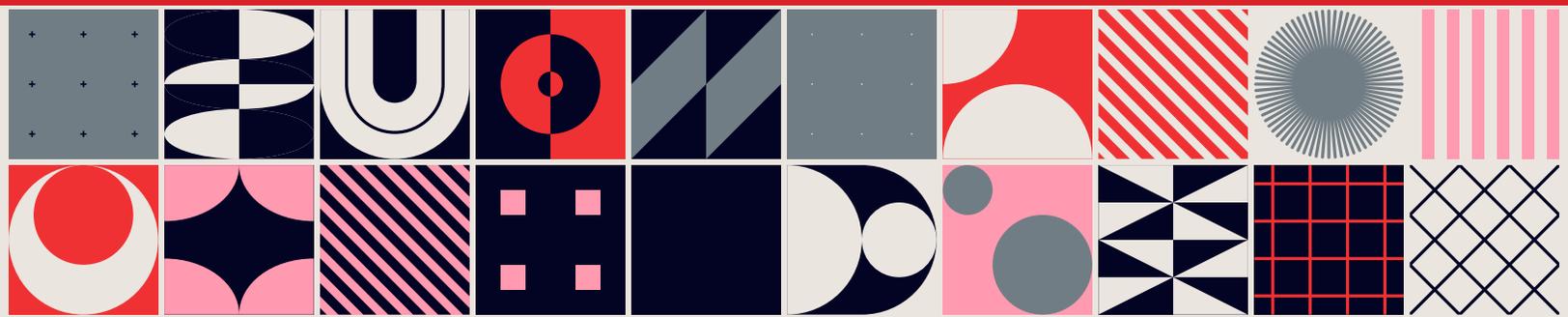
Deploying the workload

Regardless of approach or environment, many developers will likely follow similar steps in this part of the application modernization process. Tanzu did not complicate workload deployment or create daunting obstacles.

After adding Tanzu to the vSphere environment on Dell EMC PowerEdge R740xd servers, we provided our developer access to the environment. Our developer installed `kubectl`, `docker`, and Tanzu Kubernetes Grid CLI on an Ubuntu 18.04.5 VM. Then, they connected to the supervisor control plane cluster address and downloaded the "vSphere for kubectl" plugin. They prepared the VM with the necessary files and connected to Tanzu K8s. Using YAML files, they deployed a cloud-native WordPress workload to the environment. See the [science behind the report](#) for a walk-through of the developer's steps.



Figure 3: A screenshot of a successful WordPress installation after deploying Tanzu to the VMware vSphere environment. Source: Principled Technologies.



Conclusion

Modernizing applications means being able to meet the challenges of today's and tomorrow's disruptive technologies. For organizations using K8s, part of the work of modernization is developing applications and microservices in containers but managing and creating single containers can slow the modernization process. Organizations need future-ready infrastructure that can manage and create container clusters quickly and easily at scale. In our data center, Dell EMC PowerEdge R740xd servers successfully supported the latest VMware vSphere update, version 7.0 Update 1, and VMware Tanzu for Kubernetes management. Our administrators found the solution straightforward to deploy, requiring seven tasks for the Dell EMC PowerEdge R740xd server cluster.

Because VMware Tanzu centralizes K8s management, the solution increases agility by potentially streamlining hardware management processes. Based on our research, an organization could get the benefits of centralized K8s for the cost of \$161,830, which includes the per processor license cost and our three-server cluster.

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- 1 VMware, "VMware Tanzu solution brief," accessed October 15, 2020, <https://d1fto35gcffzn.cloudfront.net/tanzu/VMware-Tanzu-Solution-Brief-0920.pdf>.
 - 2 VMware vSphere Blog, "vSphere 7 – Introduction to Tanzu Kubernetes Grid Clusters," accessed April 21, 2021, <https://blogs.vmware.com/vsphere/2020/03/vsphere-7-tanzu-kubernetes-clusters.html>.
 - 3 On April 19, 2021, we obtained a reseller quote to closely match the system we tested for the purposes of the cost discussion. The differences between our reseller quote and our tested system were minor and as follows:
 - The tested system included H730P mini PERC while the quote included H730P PERC.
 - The tested system included a single SAS SSD while the quote included a 480GB SATA SSD.
 - The tested system did not include a BOSS card while the quote included a BOSS card.
 - The tested system included a quad-port QLogic 57800 10GbE NIC while the quote included an Intel X550 Quad Port 10GbE NIC.
 - The tested system included a dual port Broadcom® P225p 10/25GbE NIC while the quote included a Broadcom 57414 Dual Port 10/25GbE NIC.
 - 4 VMware Store, "VMware Tanzu Basic - Per CPU," accessed April 21, 2021, <https://store-us.vmware.com/vmware-tanzu-basic-per-cpu-5471172000.html>.

Read the science behind this report at <http://facts.pt/j8s8kdy> ►



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