

WHITE PAPER

FIVE REASONS YOU SHOULD RUN CONTAINERS ON BARE METAL, NOT VMS

Over the past 15 years, server virtualization has become the preferred method of application deployment in the enterprise datacenter. Popular hypervisors, such as VMware ESXi and Microsoft Hyper-V, are ubiquitous. Large cloud providers such as Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform have followed a similar path. The most common unit of consumption for infrastructure as a service (IaaS) is a virtual machine (VM).

However, in the cloud native era many organizations are seeking faster and more flexible methods for deploying and managing new applications and delivering new software features to increase customer engagement. As a result, it is often necessary to run applications in both on-premises datacenters and cloud environments. Driven largely by the needs of these new applications and the developers creating them, enterprises are deploying containerized applications in addition to monolithic applications running in VMs.

If your organization is adopting containers, you may be working hard to understand what infrastructure options are best for your business. Given the substantial capital investments you have made in virtualization and the years of experience your team has managing VMs, it's natural to consider running your container environment within your virtualization environment.

A lot of infrastructure teams do just that. It's a good way to get familiar with containers. But, as teams progress from proof-of-concept to development and testing and then to production deployment, there are cases where VM-based containers are less than ideal. Many gravitate naturally toward running containers on bare metal for the following reasons:

- Fewer layers to manage and simpler troubleshooting
- Higher efficiency
- More containers per server
- Better, more predictable performance
- Lower total costs

This paper explains the advantages of bare-metal containers versus VM-based containers and describes how the Diamanti bare-metal container platform can help your team achieve its objectives quickly and easily.

1. VM-BASED CONTAINER MANAGEMENT

When you deploy containers on top of an existing virtual environment, you are layering one form of virtualization on top of another. The people using and managing the container environment are likely not the same ones managing the VM environment. No matter how well your container, virtualization, and infrastructure teams work together, there will inevitably be communication problems, duplication of effort, and unavoidable delays as one team waits on another.

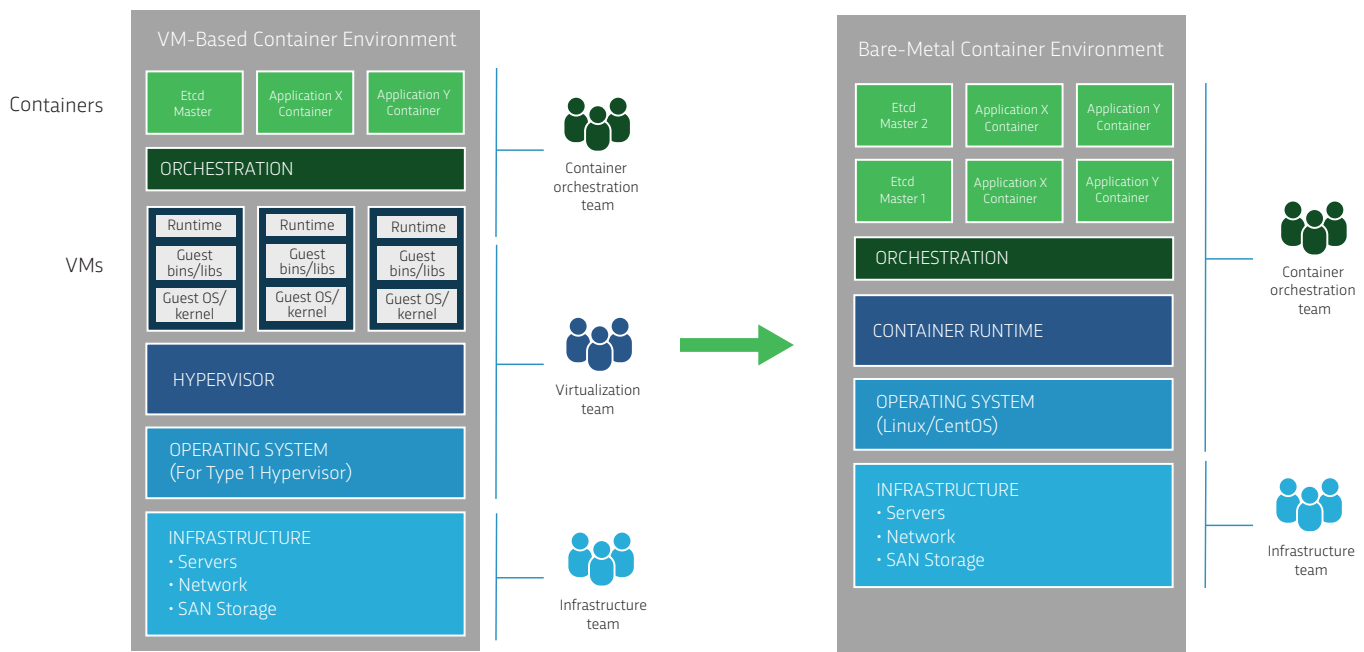


Figure 1: Fewer teams need to be involved in bare-metal container deployments, streamlining management and troubleshooting.

You might choose to organize things differently, but if a problem arises, troubleshooting is still more complex than it would be in a simpler environment. Can the problem be fixed at the container level? Is it a virtualization problem? Is something wrong with the physical hardware? If you have to call support, where do you start? Is the container stack even supported in the virtual environment or are you on your own?

If you are new to containers, it is tempting to think that familiar VM management tools such as live migration will be extremely useful in container environments. While this may be true to a point, individual containers are stateless and ephemeral. Rather than moving a running container from one host to another as you would with a VM, you just start a new instance on the other host.

Bare-metal containers reduce the number of layers to manage versus VM-based containers, and because bare metal is more efficient, you need less hardware to run the same number of containers, reducing the total amount of equipment under management.

2. VM-BASED CONTAINERS REDUCE UTILIZATION AND EFFICIENCY

Virtual machines have a substantial footprint in terms of CPU, memory, and storage capacity. Each VM consumes storage for a full guest OS plus CPU and memory to run all the necessary system processes before your application code even starts. VMs are assigned resources at start-up time and they tend to tie up those resources whether they are using them or not.

Containers running on bare metal utilize system resources more efficiently than VM-based containers. The average resource utilization in VM-based container environments may be as low as 15%. By contrast, purpose-built bare-metal stacks such as Diamanti achieve average resource utilization rates as high as 90%.

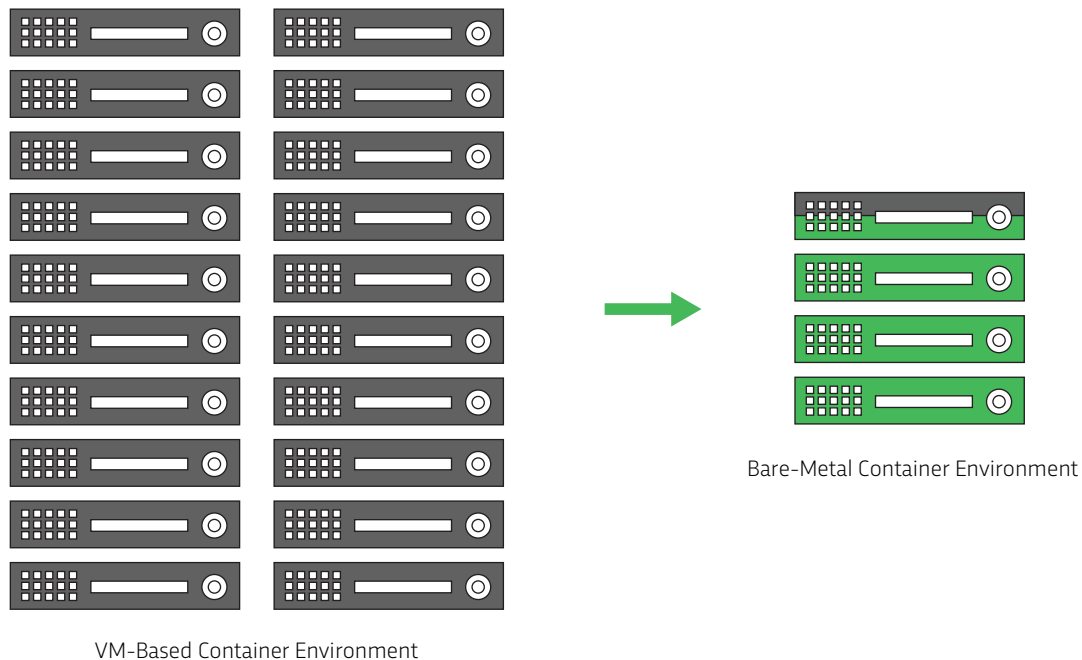


Figure 2: VM-based containers can require up to 5x the infrastructure to run the same workload.

To put this in more concrete terms, at these utilization rates, a set of containers that would need 20 servers to run in a VM-based environment would need fewer than four servers to run in a bare-metal environment. The VM-based environment requires significant overprovisioning relative to the bare-metal environment and creates a much larger footprint in your datacenter.

3. VM-BASED CONTAINERS HAVE MUCH LOWER DENSITY

An important corollary to the bare-metal efficiency advantage described in the previous section is density. Because containers are lightweight, one of their advantages is the ability to run a greater number of containers per server than VMs. As Figure 3 suggests, bare-metal container deployments support far greater numbers of containers per host.

In practice, the issue of density in VM-based container environments is exacerbated by “noisy neighbor” problems. Multiple different application containers running inside a VM contend for the VM’s limited CPU, memory, and I/O resources; a busy or misbehaving container can interfere with the performance of the others. Because virtualization management solutions don’t help much with debugging this problem, the solution is often to run just one container per VM. At this point the number of containers a server can support becomes equal to the number of VMs it supports, eliminating any density advantage.

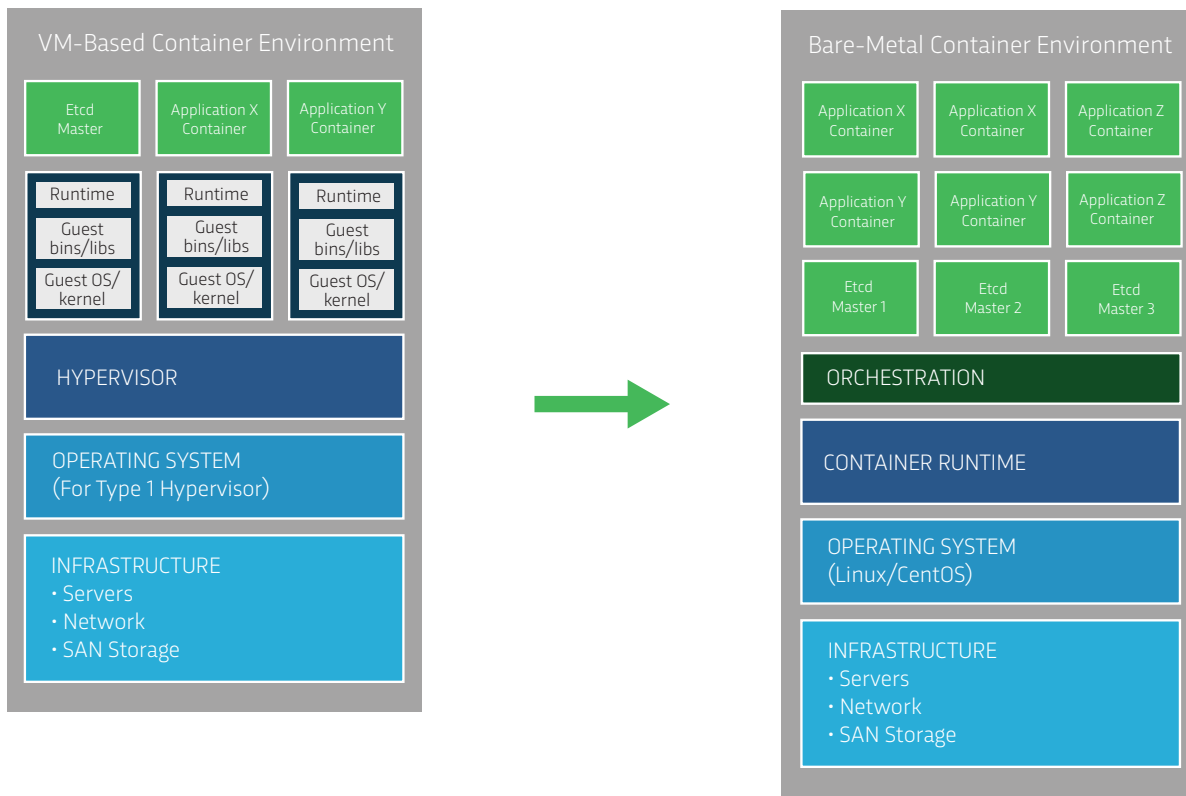


Figure 3: Due to noisy neighbor problems and networking complications, VM-based container environments support far fewer containers per physical server.

Many who have deployed containers on VMware have found VMware networking to be a limiting factor. The worst-case scenario results in deployment of a single container per VM, once again eliminating the density advantage of containers.

4. PERFORMANCE OF VM-BASED CONTAINERS IS CONSTRAINED

As with any computing environment, container performance is a function of both CPU/memory performance and I/O performance. Some containerized applications can be compute-heavy, some I/O-heavy, others more balanced.

The preceding sections on efficiency and density show that, in aggregate, bare-metal container environments deliver more performance per server, but what about the absolute performance of individual containerized applications? Again, bare metal offers a measurable advantage.

One study compared the performance of VM-based containers running in an AWS EC2 instance with the same containers running on bare metal on an identically configured server. The bare-metal container benchmarks demonstrated a 25-30% advantage over VM-based containers in both I/O and CPU performance. That means fewer containers of a given type are needed to accommodate a given workload, which reduces the total number of containers you need to have running at any given time.

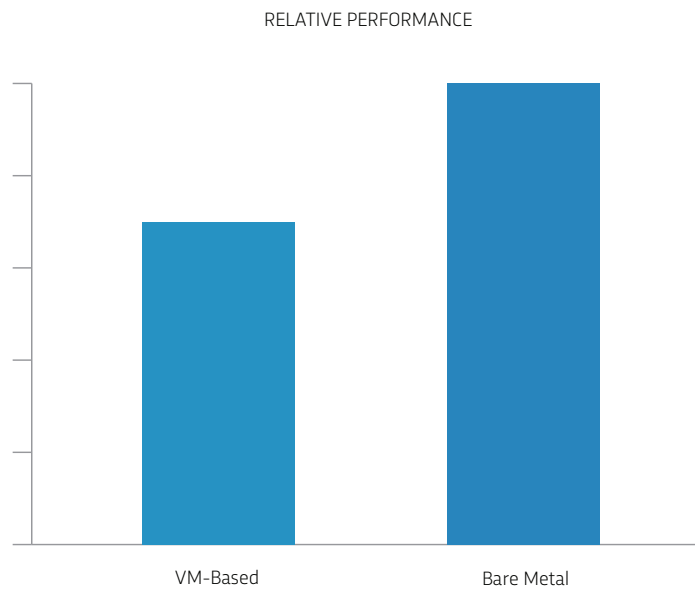


Figure 4: Individual containers deliver up to 30% greater compute and I/O performance in a bare-metal environment.

5. VM-BASED CONTAINER STACKS HAVE A HIGHER TCO

The advantages described in the previous sections all add up to substantial total cost of ownership (TCO) advantages for bare-metal container deployments:

- **Management simplicity.** Because VM-based container environments have more layers to manage, bare metal can be simpler to troubleshoot and support, reducing operating costs.

- **Density.** The number of containers per server is far higher in a bare-metal environment than a VM-based environment.
- **Utilization and efficiency.** Higher utilization translates to a smaller datacenter footprint, lower power and cooling costs, as well as further reductions in management expenses.
- **Performance.** Individual containers have higher compute and I/O performance, so fewer total containers are required.

A final cost consideration in VM-based container environments is the licensing fees that come with some virtualization software. Sometimes referred to as the vTax, a large VM-based container deployment can incur substantial licensing fees that add to your total costs.

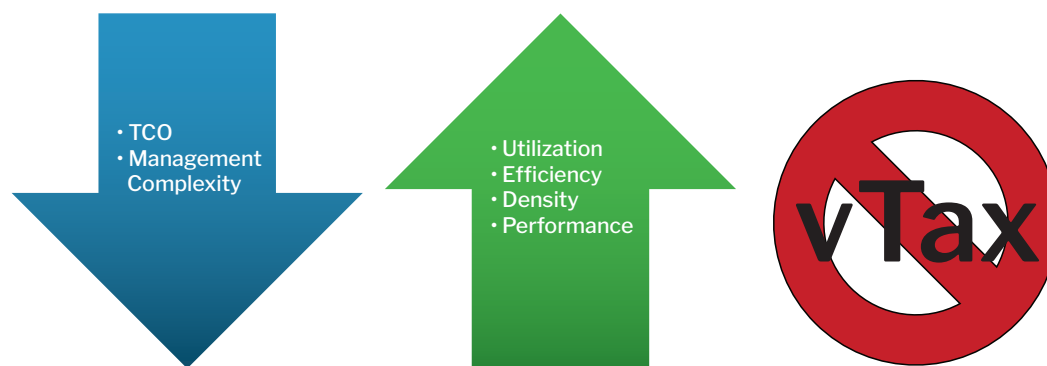


Figure 5: Bare-metal container environments reduce TCO by simplifying management, driving up density, utilization, and performance, and eliminating the cost of virtualization licensing.

6. DIAMANTI TAKES BARE-METAL CONTAINER ADVANTAGES TO THE NEXT LEVEL

The advantages of bare-metal versus VM-based container deployments are compelling for enterprises interested in containerized applications. However, do-it-yourself (DIY) bare-metal deployments can pose significant challenges:

- Do you want servers with internal storage or servers with separate storage arrays?
- What version of Linux?
- Docker or a different container environment?
- What orchestration platform?
- Open-source or packaged software distributions?
- What additional software do you need for everything to work together?
- How will the resulting solution integrate with your existing datacenter infrastructure?
- How will you get support?

If your team is new to container technology—or just needs to get a project off the ground quickly—the process can be time consuming. In today’s rapidly evolving IT world, the question of buy versus build has become a critical one.

Legacy infrastructure can’t match the agility and speed of containers. Your team can waste a lot of time and resources trying to leverage outdated networking and storage to support containerized applications. The result is slower time to market, rising personnel and equipment costs, and growing frustration between developers and IT operations.

Diamanti bare-metal container platform gives infrastructure architects, IT operations, and application owners the speed, simplicity, efficiency, and control they need to run stateful containerized applications from development through to production-scale deployment. Diamanti looked at the rapidly growing container ecosystem and recognized a need for container infrastructure that is fast and easy to deploy. The Diamanti bare-metal container platform offers the benefits of hyperconverged infrastructure for a containerized world, providing fast installation, simple management, and bare-metal container, network, and storage resources integrated with Docker and Kubernetes. Diamanti appliances are so simple, that your container team can perform infrastructure tasks without the need to involve the infrastructure team every time.

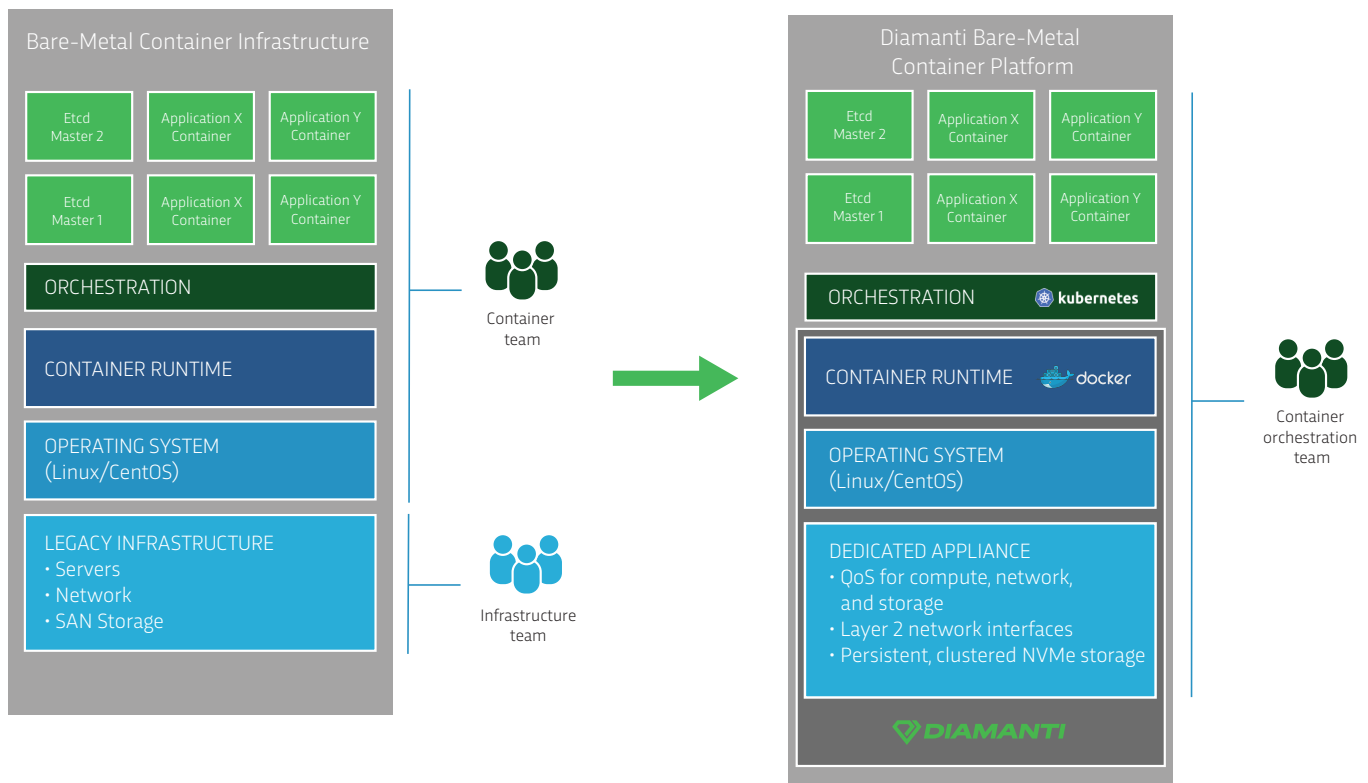


Figure 6: Diamanti integrates and further simplifies the bare-metal container environment.

As Table 1 demonstrates, the Diamanti bare-metal container platform builds on the advantages of bare-metal containers in every dimension.

Table 1: Advantages of the Diamanti bare-metal container platform for all criteria discussed in this paper.

Diamanti Bare-Metal Container Platform
<p>Simplicity Across the Container Stack</p> <ul style="list-style-type: none"> ▪ Easy to buy. Each hyperconverged cluster incorporates a pre-tested full container stack. ▪ Easy to deploy. Each plug-and-play cluster requires no hardware setup, VMs, or OS installation—all with one vendor, one maintenance contract, and one support number for the entire container stack. ▪ Easy to manage. Diamanti's self-service model enables developers to manage container infrastructure without IT tickets. ▪ Easy to scale. Manage networking, storage, and capacity with just a few clicks.
<p>Diamanti Bare-Metal Container Platform</p> <ul style="list-style-type: none"> ▪ Use less infrastructure. Reduce hardware requirements 50% while accelerating performance. ▪ Superior integration. A perfect fit with modern container, cloud, and open-source workflows.
<p>Maximum Density</p> <ul style="list-style-type: none"> ▪ Reduce hardware footprint. Compact appliance integrates compute, storage and networking. Just 3U for a three-node cluster. ▪ Run more containers per unit of rackspace. Diamanti runs far more containers than conventional bare-metal or VM-based alternatives.
<p>Predictable Performance</p> <ul style="list-style-type: none"> ▪ Rapid setup. Deploy fully supported, enterprise-class container infrastructure in 15 minutes. ▪ Quality of Service. QoS with granular controls for compute, network, and storage. ▪ Maximum I/O. Achieve 2,400,000+ IOPS per three-node cluster. ▪ Lowest latency. Reduce cross-cluster latency to 100µs with NVMe storage in each node.
<p>Up to 70% Lower TCO</p> <ul style="list-style-type: none"> ▪ Fast installation, simple management. Reduce operational costs. ▪ High efficiency and density. Lower upfront capital costs. Smaller footprint reduces operational costs.

With Diamanti, you maximize the agility and performance of containers, from development through to production-scale deployment. The Diamanti bare-metal container platform is purpose-built for modern cloud and open-source environments, delivering the benefits of hyperconverged infrastructure with industry-leading speed, simplicity, efficiency, and control.

For more information, visit www.diamanti.com.

To request a demo, email demo@diamanti.com.