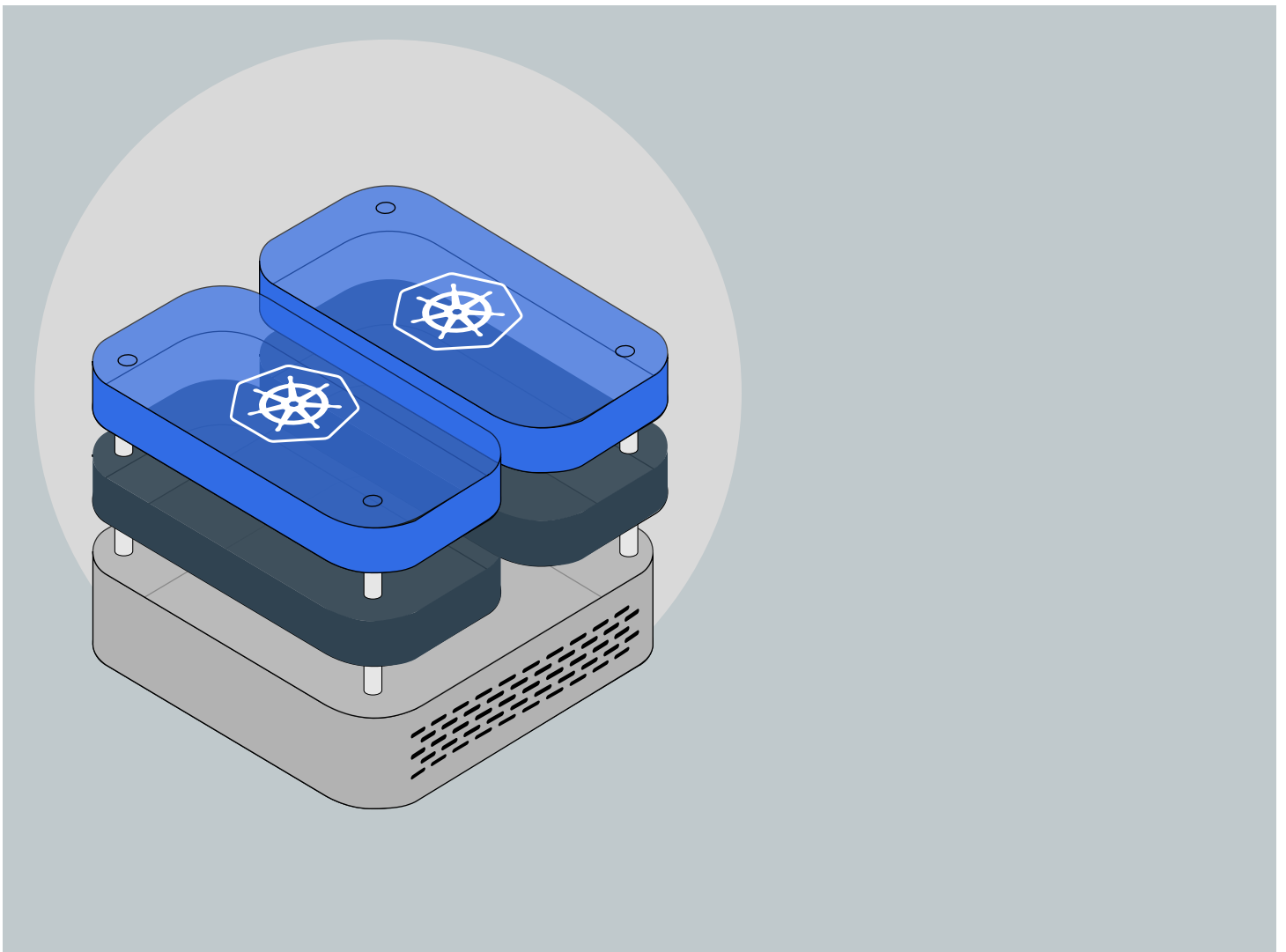


Kubernetes unleashed

Powering bare metal workloads



Kubernetes unleashed: Powering bare metal workloads

Expectations for businesses have changed drastically over the past decade — 70 percent of all customer experiences are now digital, according to a [2024 Salesforce report](#). And that number is even higher for ecommerce, software, and media brands.

Websites aren't just the new brick-and-mortar store; they're a destination where customers expect 24/7 access to seamless digital experiences. These new expectations extend beyond the enterprise level, causing mid-sized and even small business owners to rethink their relationship with the cloud.

Our 2024 [State of the Hosting Industry Report](#) found that just over 47 percent of leaders at enterprise and mid-level businesses see the benefit of hybrid hosting solutions that combine the benefits of physical infrastructure and cloud technology.

Nearly 90 percent of these leaders are realizing the benefits of edge computing by integrating cloud technology into their infrastructure for use cases like:

- Internet of Things (IoT) applications
- Geo-distributed caching
- Management of sensitive data
- Streaming and online gaming
- Integration of AI and machine learning

In this whitepaper, we'll explore everything you need to know about using bare metal cloud and Kubernetes as the hybrid hosting solution to power your online business.

The key ingredients of agile, scalable web hosting

Achieving agile and scalable web hosting hinges on selecting the right underlying technology and your business needs. Three primary options exist for hosting digital environments: Bare metal, virtual machines (virtualization), and Kubernetes (containerization.)

Bare metal: Performance and security

Bare metal refers to physical computer servers dedicated entirely to a single tenant. This gives users exclusive control over the server, including the choice of operating system, hardware configurations, and optimal resource utilization.

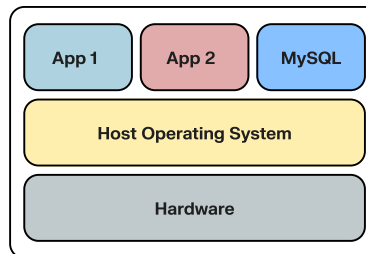
Bare metal is ideal for resource-intensive applications such as high-performance computing, large databases, and applications requiring real-time processing.

Virtual machines: Scalability and cost savings

Virtual machines (VMs) are software-based emulations of physical computers. They allow you to split up a single piece of hardware into multiple isolated environments, each with its own operating system, applications, and resources. This is enabled by a hypervisor — a software layer that allocates physical resources — like CPU, memory, and storage — among the various VMs.

VMs are particularly valuable for testing operating systems, running legacy applications, or maintaining different application environments on a single server.

Bare metal



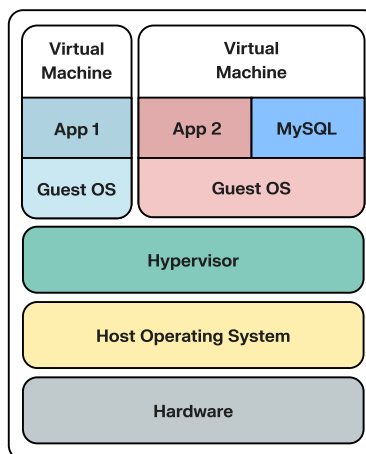
Advantages:

- High performance and efficiency
- No resources used for virtualization
- Reliable and secure

Disadvantages:

- Expensive to scale
- Hard to manage

Virtualized



Advantages:

- Flexibility and scalability
- Fewer hardware resources
- Managing diverse workloads

Disadvantages:

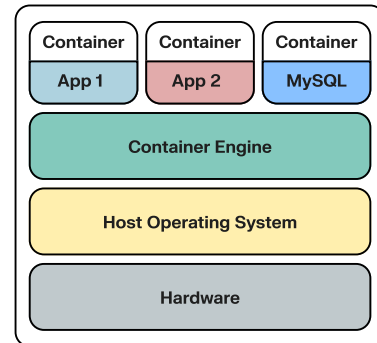
- Noisy neighbor problem
- Vulnerable to attacks

Containers: Resource provisioning and agility

Containers are a technology that allows developers to package an application plus its dependencies — libraries, binaries, configuration files, and other necessary components — into a single, lightweight, executable package. This encapsulation ensures the application runs quickly and reliably from one computing environment to another.

The magic of containers lies in their efficiency and portability. Unlike VMs that require a full-blown operating system to run each application, containers share the host system's kernel, making them much more resource-efficient and faster to start.

Containerized



Advantages:

- Efficiency and portability
- Fast start-up time
- Microservice deployment

Disadvantages:

- Vulnerable to attacks
- Overprovisioning



Kubernetes:

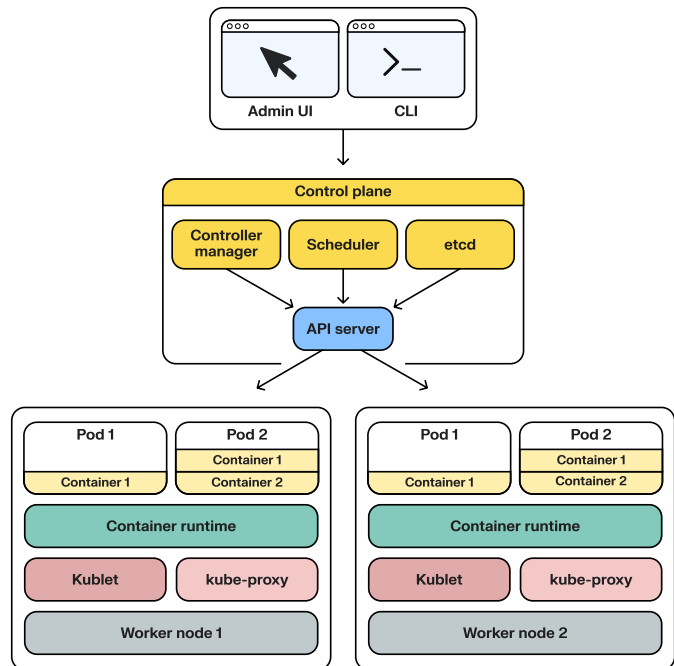
Container orchestration

Kubernetes is an open-source platform designed to automate containerized applications' deployment, scaling, and operations.

As containers have become a popular way to package and run applications, Kubernetes offers a framework for managing these containers at scale. It handles the distribution of containers across a cluster of servers, balancing loads effectively to ensure that applications remain highly available and responsive.

Kubernetes provides a suite of features for service discovery, autoscaling, rolling updates, and self-healing. This makes it easier to build, deploy, and manage applications— so businesses can continuously deploy and scale without downtime.

Kubernetes has become the de facto standard for container orchestration, supported by a large and active community, driving innovation in cloud-native applications.



Advantages:

- Highly scalable
- Provides a consistent platform across different environments
- Failure detection and response

Disadvantages:

- Kubernetes has a very steep learning curve
- Requires significant resources, such as storage, memory, and CPU

It's easy to get lost in all the terminology and concepts of cloud computing. Below, we'll look at one way you can think about how bare metal, VMs, containerization, and Kubernetes might apply to your business.

Imagine your business as a bustling city. In this city, the technological infrastructure you select — bare metal servers, virtual machines (VMs), containers, and Kubernetes — plays a crucial role in its efficiency and growth. It's like urban planning.

- **Bare metal:**

The land – Bare metal servers are your city's foundation. Just as land offers a solid base for development, bare metal provides dedicated resources for high-performance applications, establishing a strong and unshared base for your business operations.

- **Virtual machines:**

The skyscrapers – VMs are the skyscrapers of your city. They allow you to efficiently utilize the underlying server's resources by dividing it into smaller, isolated environments. This flexibility is similar to allocating different skyscrapers' floors for various purposes, optimizing space and resources while ensuring security and isolation.

- **Containers:**

The units – Containers represent the individual spaces within the skyscrapers. They provide a lightweight method for packaging and running applications, including all necessary dependencies. This approach maximizes resource use, enabling rapid scaling and deployment, like furnishing new apartments quickly to meet rising demand.

- **Kubernetes:**

The city planner – Just as a city planner manages urban development and public utilities, Kubernetes optimizes application performance and resilience, adjusting resources to meet the city's (business's) evolving needs. Kubernetes automates applications' deployment, scaling, and operation, ensuring that resources are used efficiently and applications run smoothly.

Bare metal servers

High-performance gaming servers:

Online gaming platforms, especially those hosting multiplayer games, require low-latency, high-performance servers to ensure a seamless and lag-free experience for players. Bare metal servers, with their dedicated resources, provide the raw power and performance stability needed for these demanding environments.

Large-scale ecommerce platforms:

During peak shopping seasons, ecommerce sites experience spikes in traffic that demand high computing and processing power to handle thousands of simultaneous transactions without performance degradation.

Bare metal servers offer the scalability and reliability these platforms need to maintain customer satisfaction and sales efficiency.

Virtual machines

Web development and testing environments:

Businesses often need isolated environments to develop, test, and stage web applications before going live. VMs provide a cost-effective and flexible solution, allowing developers to replicate production environments, experiment with different settings, and manage resources efficiently without impacting the live site.

Software as a Service (SaaS) providers:

SaaS companies that offer applications to a wide range of customers require a scalable and secure hosting environment. VMs enable these providers to create isolated instances for each customer, ensuring data privacy, security, and the ability to scale resources up or down based on demand.

Containers orchestration

Microservices architectures:

Containers are ideal for businesses adopting microservices architectures. They allow individual components of an application to be encapsulated with their dependencies, facilitating easier updates, scaling, and deployment.

This is essential for companies that aim to use continuous integration and deployment (CI/CD) methodologies to speed up development cycles and improve service reliability.

Multi-tenant applications:

Applications that serve multiple tenants (customers or users) from a single application instance must ensure isolation, efficiency, and scalability.

Containers provide a lightweight environment to deploy these multi-tenant applications, enabling businesses to optimize resource use and streamline the deployment process. This ensures a consistent and isolated experience for each tenant while maximizing server efficiency.

Each hosting solution offers unique advantages tailored to specific business needs, from the raw power of bare metal for performance-intensive applications to the flexibility and scalability of VMs and containers for development and microservices deployment. Understanding these solutions allows businesses to select the most appropriate hosting strategy to ensure operational success and growth.

Ultimately, the journey towards agile and scalable web hosting is about making informed choices that align with your business's current needs and future growth aspirations. Whether it's the dedicated power of bare metal, the flexibility of VMs, or the efficiency of Kubernetes, the goal remains the same: to build a resilient, high-performing digital presence that can stand the test of time and scale.

Understanding hosting with bare metal Kubernetes

Since being [open-sourced by Google in 2014](#), Kubernetes has taken over cloud environments with its efficient container management. Amazon, Google, and Microsoft all offer managed Kubernetes solutions under their cloud services. As of 2022, approximately [60 percent of surveyed organizations](#) have adopted Kubernetes.

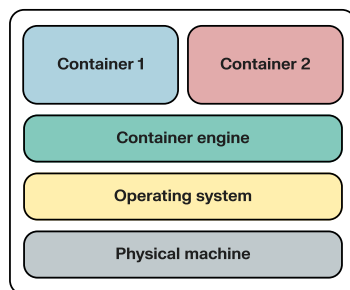
As businesses seek to leverage Kubernetes, they encounter a pivotal choice: deploying on bare metal servers or within VM environments. This decision can significantly impact performance, manageability, and cost efficiency.

The diverging paths of Kubernetes deployment

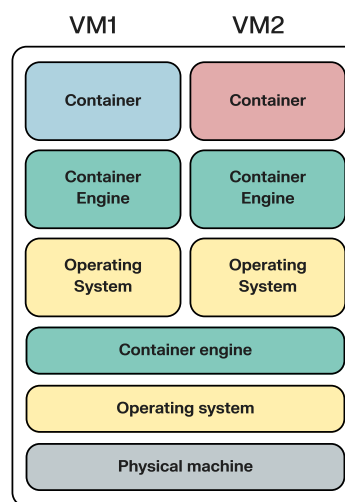
The primary advantage of bare metal Kubernetes (BMK) lies in its ability to access the hardware's full potential. In many cases, this reduces overhead and enhances the performance of containerized applications.

VM-based Kubernetes, on the other hand, involves deploying Kubernetes within virtual machines that live on a hypervisor. VM-based deployments abstract the hardware layer, simplifying the setup and scaling of Kubernetes clusters but at the cost of resource overhead due to virtualization. It's kind of like constructing on a prefabricated platform: you can build faster and more cost-efficiently, but you won't get the reliable performance of a custom product.

Bare metal Kubernetes vs VM-Based Kubernetes



Bare metal Kubernetes



VM-based Kubernetes

[Recent head-to-head tests conducted by Gcore](#) show a decided advantage when using bare metal Kubernetes vs VM-based Kubernetes across numerous performance benchmarks.

- **CPU performance:**

BMK significantly outperformed its VM counterpart, with CPU speeds more than twice as fast.

- **RAM efficiency:**

The bare metal setup showed about three times faster performance for both write and read operations.

- **Storage superiority:**

BMK was more than twice as good in terms of Transactions Per Second (TPS) and had much lower latency.

- **Network capability:**

The bare metal cluster provided up to five times greater bandwidth and up to six times lower latency than the VM cluster.

While these performance differences can vary depending on the specifics of the VM setup, most businesses with high-performance needs can expect better performance with BMK.

Synergizing bare metal and Kubernetes: The best of both worlds

Both bare metal servers and Kubernetes provide enticing benefits for web-based businesses — performance and control on one end, efficiency and scale on the other. Thankfully, you no longer need to choose between them. Bare metal Kubernetes combines the direct hardware access and performance advantages of bare metal servers with the agility and scalability of cloud computing.

Benefits of bare metal Kubernetes

- **Resource efficiency:**

BMK ensures optimal use of your resources, eliminating the performance penalties that virtualization takes from your hardware.

- **Direct access:**

You have direct access to physical hardware, allowing for custom configurations and optimizations that aren't possible in a virtualized environment.

- **Lower costs:**

BMK eliminates the need for hypervisors, reducing the total number of servers you need and the overall cost of your cloud environment.

- **Management and control:**

Advanced management tools and services that come with bare metal cloud solutions simplify the orchestration of Kubernetes, blending the ease of cloud management with the power of bare metal.

- **Physical isolation:**

Bare metal cloud is ideal for sensitive workloads that demand stringent data protection measures like dedicated servers.

Navigating the complexities of bare metal Kubernetes

Despite its advantages, there are trade-offs and challenges to adopting bare metal Kubernetes for your environment. Here are several factors to consider before embarking on this path:

- **Prerequisites:**

Access to bare metal servers and the technical expertise to handle the initial setup and network configurations are essential.

- **Complexity:**

Managing a bare metal Kubernetes environment requires a complete understanding of physical infrastructure and container orchestration. It takes a high level of experience to operate successfully in this environment.

- **Expertise shortage:**

The industry faces a notable talent gap, with many companies citing a lack of competency in containerization as a barrier to adoption. Moreover, many who have embraced containerization report a shortage of skilled personnel.

The latter challenge is particularly significant. According to our [2024 State of the Hosting Industry report](#), over 52 percent of businesses that don't use containerization or Kubernetes highlight a lack of competency with these technologies as the largest barrier.

Unleashing the potential:

Use cases for bare metal Kubernetes

Bare metal Kubernetes shines in scenarios where performance and hardware control are paramount:

- **Performance-critical applications:**

High-performance computing (HPC), large-scale data analytics, and real-time processing applications can benefit significantly from the reduced latency and increased throughput of bare metal Kubernetes.

- **Specialized hardware needs:**

Workloads requiring specialized configurations, such as GPU-accelerated tasks or high-capacity storage, find an ideal platform in bare metal environments.

- **Edge computing:**

In edge computing scenarios, where minimizing overhead is crucial for processing data close to the source, bare metal Kubernetes offers a lean, efficient solution.

The choice between bare metal and VM-based Kubernetes deployment hinges on balancing performance optimization and management convenience. With solutions like bare metal cloud, businesses no longer have to choose one over the other, enjoying the best of both worlds. As the demand for agility and efficiency grows, understanding each approach's nuances and its unique advantages is essential.

How bare metal cloud and Kubernetes help web-based businesses meet customer expectations

We live in the digital era where businesses face ever-increasing customer expectations for seamless, responsive, and reliable online experiences. The underlying cloud infrastructure you use plays a critical role in meeting these expectations.

Let's explore some specific scenarios where the unique advantages of bare metal Kubernetes make it the preferred choice over VM-based setups.

Scenario 1: High-traffic with bursts

Imagine your online retail website gearing up for the annual Black Friday sale. Historically, this event draws a massive surge in traffic, straining your digital infrastructure. In a VM-based setup, the added virtualization layer can hamper the ability to scale up rapidly, potentially leading to slowdowns or, worse, website outages just as countless potential buyers flock to your site.

Bare metal benefit: A bare metal Kubernetes setup shines in this high-stakes scenario. With the raw power of the underlying hardware directly at your disposal, scaling up to meet sudden spikes in demand becomes much more swift and efficient. This capability ensures that your website remains highly responsive and available, even during peak traffic times, thus enhancing customer satisfaction and maximizing sales opportunities

Scenario 2: Need for low latency

If you run an online gaming platform or a financial trading website, you know every millisecond of delay can significantly impact the user experience. Ultra-low latency is key for these businesses.

Traditional VM-based environments, with their inherent virtualization overhead and “noisy neighbors,” struggle to meet these stringent latency requirements.

Bare metal benefit: By eliminating the virtualization layer, a bare metal Kubernetes setup offers a streamlined path for data, reducing network latency. This advantage is crucial for businesses that depend on real-time interaction and data processing. Bare metal ensures the snappiest possible response times, directly translating to improved user experiences and, consequently, higher user retention and satisfaction.

Scenario 3: Specialized hardware requirements

Some applications demand specific hardware capabilities that aren't just about raw CPU or memory. For instance, advanced image processing tasks or AI model training often require powerful GPUs, while certain databases might perform best with hardware-accelerated operations.

Bare metal benefit: Bare metal cloud environments allow for complete hardware customization. You can select servers that precisely match your application's needs, whether it's GPUs for machine learning tasks or specialized networking capabilities for high-speed data processing. This level of customization typically isn't available or is severely limited in VM-based setups, making bare metal the go-to choice for hardware-intensive applications.

Scenario 4: Tight cost control with high-performance needs

High performance doesn't have to come with a high price tag. That's music to the ears of the many businesses that operate under tight budget constraints but still require top-tier performance to meet customer expectations and competitive pressures.

Bare metal benefit: Bare metal Kubernetes can offer a more cost-effective solution for performance-intensive needs compared to VMs. The elimination of the virtualization overhead not only boosts performance but can also translate into lower operational costs. With bare metal, you pay for the hardware you use without the additional cost layers associated with virtualization, making it possible to achieve superior performance while keeping expenses in check.

Making the right choice

Deciding between a bare-metal and a VM-based Kubernetes setup is both a technical and a strategic decision — one that significantly affects your ability to compete and satisfy customers.

The scenarios outlined above highlight situations where the unique benefits of bare metal Kubernetes make it the superior choice. That said, you should always make hosting decisions based on a thorough analysis of your specific needs, performance requirements, and budgetary constraints.

If your business checks any of these boxes, you may want to invest in bare-metal Kubernetes:

- ☑ High traffic volumes with unpredictable bursts
- ☑ Requiring low latency for interactive applications
- ☑ Specialized hardware requirements
- ☑ Balancing a tight budget with high-performance needs

In embracing bare metal Kubernetes, businesses can leverage the best of both worlds: the robust performance and customization capabilities of bare metal combined with the agility and efficiency of Kubernetes.

This powerful combination ensures that businesses are well-equipped to deliver exceptional online experiences that meet the high standards of today's digital consumers, ultimately driving success in the competitive online marketplace.

Bare metal cloud hosting with Liquid Web — enterprise scale and SMB agility

Consumers now expect all web-based businesses, even SMBs, to provide high-quality digital experiences at low latency and keep up with the latest trends in web design and functionality.

Meeting this benchmark is even more challenging when you have an IT talent shortage compounds these challenges. In fact, [61.58 percent](#) of companies that have adopted containerization list a lack of talent as their top concern.

How are businesses without the IT talent of large enterprises supposed to remain competitive and innovative?

Liquid Web [Cloud Metal](#) bridges this gap, offering SMBs the power and reliability of enterprise-scale hosting with the agility and personal touch they require.

Unlike traditional cloud hosting solutions, our bare metal cloud hosting offers the raw performance and security of dedicated hardware combined with the flexibility and scalability of cloud technology. This combination is particularly appealing for businesses looking to harness the full potential of their online presence without the complexity and resource requirements typically associated with such high-performance solutions.

What sets Liquid Web's service apart for growing and mid-sized businesses is our technological prowess and customer-centric approach. We understand the importance of support and simplicity for SMBs — we've been working with them for over 20 years. That's why we offer:

- ☑ Customizable managed services
- ☑ Expert guidance
- ☑ 24/7/365 customer support

Liquid Web Cloud Metal lets you focus on growth rather than getting bogged down by technical details.

[Contact us](#) to get started with Cloud Metal today.