

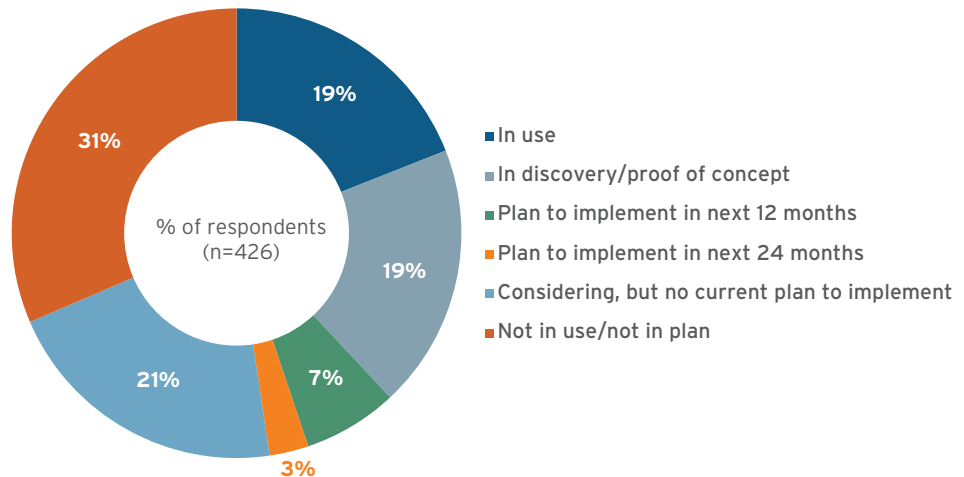
# Kubernetes: Making Containerized Databases a Reality

## The 451 Take

Interest in containers to support microservices architectures and business agility is growing rapidly. Data from 451 Research's Voice of the Enterprise service indicates that 48% of enterprises have already adopted or are actively planning to adopt containers and container management (see figure below). Containers provide agility and repeatability in terms of packaging and deploying applications by enabling the applications to be quickly spun up and down as required.

### Container Implementation Plans

Source: 451 Research, Voice of the Enterprise: Storage, Workloads and Key Projects 2018



The dynamism that containers bring is ideal for stateless Web applications, but it can be problematic for stateful database workloads, given the need for a persistent connection between the application and its associated data volume. As enterprises have enjoyed the business agility and architectural benefits of containers for stateless applications, container platform functionality has also begun to evolve to better enable databases to run in containerized environments. The Kubernetes container orchestration system has become a focal point for advances that enable managing containers in a way that adapts to constantly changing enterprise environments, and has recently evolved to provide the beginnings of a viable long-term approach to containerized databases.

There are a number of key capabilities offered by Kubernetes that enable the containerization of stateful services. The concept of Pods, which supports the deployment of a collection of containers on a single host, remains at the core. StatefulSet, which provides identity guarantees for containers deployed in a Pod, is important for nodes in a distributed database, while custom controllers automate the lifecycle of the deployment as a whole. Additionally, the combination of PersistentVolume and PersistentVolumeClaim ensures that the connection with an associated storage volume will also be automatically restored in the event of the Pod being deleted and re-created.

It is still the early stages for containerized databases, and there remain inherent challenges in getting databases and containers to work together. However, Kubernetes has evolved rapidly in recent years to provide elements for persistence and cluster lifecycle management that are needed for database workloads. This, coupled with the key agility and portability benefits of containers, means Kubernetes is set to play a key role in enabling the marriage of containers and database workloads in the years to come.

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# Business Impact Brief

## Business Impact

**GREATER BUSINESS AGILITY**. As part of a cloud-native or cloud-enabled architecture, containers and container platforms promise to allow enterprises to improve their agility and become more responsive to changing business requirements. For developers, containers can increase efficiency by being an enabler of microservice-based application architectures, as opposed to traditional monolithic approaches.

**DEPLOYMENT FLEXIBILITY**. Containers can be used as a means to facilitate hybrid cloud deployments and digital transformation initiatives. In terms of cloud, the portability of containers can enable the movement of workloads between private and public clouds, for example.

**PROVISIONING AND RESILIENCY IMPROVEMENTS**. Container orchestration has the potential to improve provisioning speeds. In addition, our research shows that 47% of enterprises expect that containers will provide improved resiliency compared with VMs, since the lightweight nature of containers imbues them with the potential to recover more quickly after a failure.

**EVOLVING SUPPORT FOR STATEFUL DATABASE WORKLOADS**. The container orchestration capabilities of Kubernetes have evolved, with a collection of primitives that combine to guarantee stable, persistent storage for a Pod, or collection of containers. This persistence is a requirement for supporting stateful workloads.

## Looking Ahead

Cloud-native approaches – including containers, microservices and serverless computing – have the potential for a profound impact on the IT landscape by enabling the rapid development and deployment of applications, as well as driving greater business agility and architectural flexibility. Container management and orchestration will be key to delivering on this potential, providing provisioning and resiliency advantages. Kubernetes has matured rapidly to the extent that, for some, it is already the de facto standard for container management and orchestration.

451 Research estimates that the market for application containers and associated technology will grow to \$4.2bn in 2022, approximately 13% of which will be attributable to data management and data services. Given its support for functionality that makes the containerization of stateful services a reality, we expect Kubernetes to play a key role in driving the increased use of containers for data workloads.

Certainly the concept of Pods, combined with StatefulSet, custom controllers, PersistentVolume and PersistentVolumeClaim, among other things, provides the basis for creating what will initially be custom deployments for individual databases. Indeed, database vendors are beginning to update their products, via support for Kubernetes Operators and Custom Resource Definitions, to take advantage of these features.

However, vendors, enterprises and industry consortia must work together to continue to evolve Kubernetes in order to provide a general-purpose environment for the containerization of multiple stateful services.

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