

Kubernetes Infrastructure and Its Usage in a Banking System

Anirudh Mustyala, Karthik Allam

United States of America

Abstract: *In a banking system, Kubernetes infrastructure plays a vital role in several key areas. Although banks have been slow to adopt best practices witnessed in other industries, they have made huge strides in the last decade. They are heavily investing in emerging technologies and are now positioned to rank among the most pioneering organizations. In addition, banking institutions are leveraging advanced cloud solutions to make drastic technological changes to remain competitive. With innovation being a primary consideration for most banking customers, inventive leaders drive this technological change by continually strategizing, investing, and adopting technologies such as Kubernetes. Furthermore, financial technology (fintech) institutions must facilitate a constantly changing culture. Specifically, banks need to embrace a culture that provides the agility to meet constantly changing consumer needs, which primarily involves open banking. It is a process where financial institutions collaborate with partners and customers to produce innovative financial services. A significant part of successful open banking processes is leveraging technology to develop microservices instead of monolithic products. Moreover, recent global events like the COVID-19 pandemic have increased the role of fintech. For example, while consumers once considered online banking systems and applications highly convenient, they now expect financial organizations to provide a full banking experience accessible via mobile devices. 93% of millennials use mobile banking today as the preferred choice. Hence, it is now critical for institutions that provide services such as investments, taxation, credit cards, and payments to traverse technological transformation to remain competitive effectively. In other words, banks must use cutting-edge technological solutions like Kubernetes to provide on-demand financial services. Kubernetes is an open-source solution for deploying and orchestrating containers.*

Keywords: Fintech, Containerization, Infrastructure, Scalability, Elasticity, High Availability, Fault Tolerance, Security, Disaster Recovery, Business Continuity

Although banks have been slow to adopt best practices witnessed in other industries, they have made huge strides in the last decade. They are heavily investing in emerging technologies and are now positioned to rank among the most pioneering organizations. In addition, banking institutions are leveraging advanced cloud solutions to make drastic technological changes to remain competitive. With innovation being a primary consideration for most banking customers, inventive leaders drive this technological change by continually strategizing, investing, and adopting technologies such as Kubernetes.

Furthermore, financial technology (fintech) institutions must facilitate a constantly changing culture. Specifically, banks need to embrace a culture that provides the agility to meet constantly changing consumer needs, which primarily involves open banking. It is a process where financial institutions collaborate with partners and customers to produce innovative financial services. A significant part of successful open banking processes is leveraging technology to develop microservices instead of monolithic products.

Moreover, recent global events like the COVID-19 pandemic have increased the role of fintech. For example, while consumers once considered online banking systems and applications highly convenient, they now expect financial organizations to provide a full banking experience accessible via mobile devices. 93% of millennials use mobile banking today as the preferred choice. Hence, it is now critical for institutions that provide services such as investments, taxation, credit cards, and payments to traverse technological transformation to remain competitive effectively. In other words, banks must use cutting-edge technological solutions like Kubernetes to provide on-demand financial services.

Kubernetes is an open-source solution for deploying and orchestrating containers. Kubernetes provides access to virtual operating systems, allowing applications to operate flawlessly across clouds, locations, and systems. Using Kubernetes to operationalize containerization allows banking institutions to provide consumers with a smooth banking experience. Also, it allows fintech entities to automate savings, secure sensitive financial data, and innovate new solutions. Kubernetes container orchestration is ideal for banking institutions, regardless of whether they host their technology stacks in the hybrid, private, or public cloud model. Kubernetes enables banks to create and deploy containerized applications whose architecture is centered on cloud-native, microservices and API-first approach.

Leveraging Kubernetes to meet the needs of banking institutions

Financial institutions need to deliver new services rapidly and at scale. Container orchestration using Kubernetes has become essential to meeting this demand. In particular, containers allow organizations to package applications that run consistently across different cloud environments. As a result, this makes it easy to install and maintain applications, which is especially important in today's fast-paced technology landscape. Unsurprisingly, as Kubernetes adoption increases, auxiliary workloads (63%) outnumber application workloads (37%). It implies that organizations are implementing more advanced Kubernetes technologies, such as messaging systems security controls, and service meshes. Banks can leverage these capabilities to provide more effective, secure services.

Volume 12 Issue 5, May 2023

www.ijsr.net

Licensed Under Creative Commons Attribution CC BY

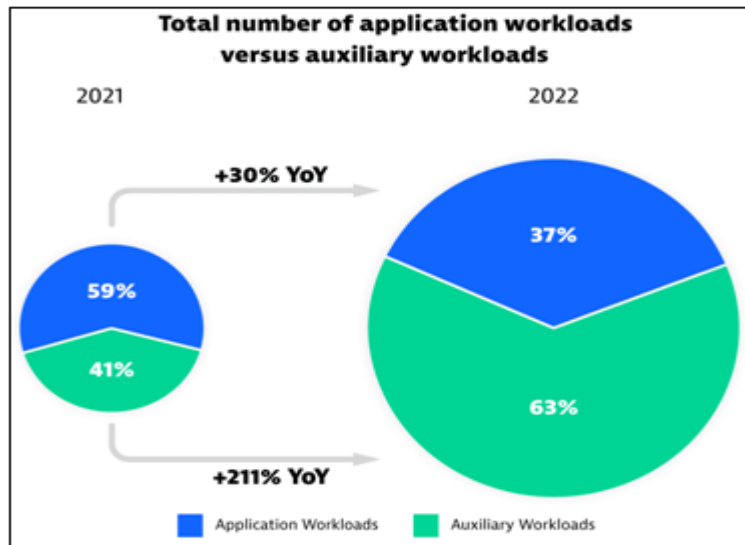


Figure 1: More companies adopting advanced Kubernetes technologies

Moreover, developers use containers to package code and dependencies, creating standardized code units that can be easily reused and scaled up or down as needed. At the same time, developers can consistently package them into a single object that can run in different cloud environments. Thus, it simplifies how banking institutions create and manage applications since they will work consistently across multiple environments. Furthermore, packaging code and dependencies into containers allow developers to use them as consistent building blocks. It simplifies software deployment and enables efficient application scaling to meet the needs of a growing customer base.

Additionally, containers to orchestrate containers help financial institutions to reduce their IT costs. More containers can be packed on server instances to run more applications, thus minimizing the resources required to run applications in different environments. Also, containers allow banks to build application workflows that can be between cloud and on-premises. It hence allows financial institutions to operate in any hybrid environment smoothly. This means that IT teams can run the same application with less infrastructure leading to significant cost savings. Organizations are racing to adopt Kubernetes to exploit these benefits, with 61% having adopted Kubernetes infrastructure by the end of 2022.

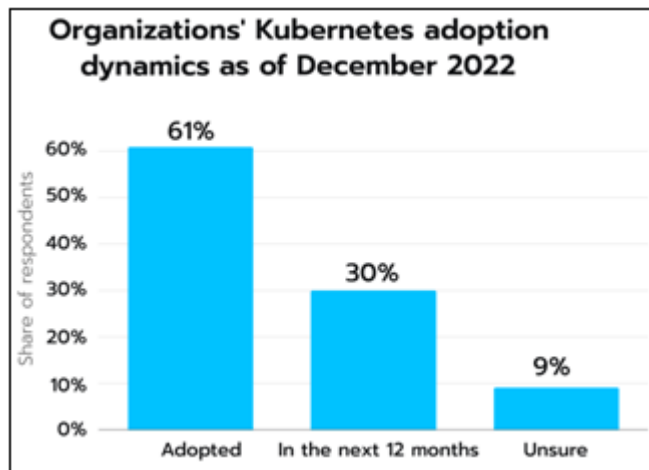


Figure 2: 61% of companies adopted Kubernetes by the end of 2022

Besides, containers enhance developer productivity. They allow financial institutions to create, test, and deploy applications quickly. In particular, the consistency of containers across different environments eliminates concerns about whether an application will run properly on a different environment or local machine. Containers run the same in the environment where they are orchestrated and can start or terminate rapidly, enabling unlimited scalability for running applications. Thus, they reduce friction in developing applications required to deliver business objectives. Containers also accelerate the time to market new products. Essentially, Kubernetes is a powerful tool that can help

banking institutions to streamline the entire development and deployment process, making it easier for developers to create and manage financial systems.

Furthermore, Kubernetes allows banks to manage system complexity easily. As enterprise software increases in complexity, DevOps teams require to orchestrate that complexity for easier system management. Kubernetes allows teams to manage the lifecycle of containers, automate deployments, and manage scaling. It simplifies software complexity management, which is critical for financial institutions that maintain large, complex applications.

The benefits of Kubernetes infrastructure in the banking system

Over the past few years, there have been a lot of debates on the need for organizations to adopt a "cloud native" approach. The aim is to meet increasing customer demands and accelerate the time to market for new services. Simply put a cloud-native strategy for application development and deployment helps achieve cost savings, accelerate the development of new services and products, and quickly scales up services. Kubernetes provides the underlying infrastructure and foundational building blocks required for a cloud-native strategy. It is increasingly becoming the go-to technology for established banking institutions and startups due to the following reasons:

1. Meeting the Needs of the Modern Customer

Customer demands and needs have increased tremendously in recent years. In addition, online banking has evolved from being only an addition to traditional banking practices to being the primary way customers conduct their financial transactions. As a result, businesses must create and deploy new ideas more quickly and consistently while maintaining product quality and security.

Furthermore, customers no longer need to visit bank branches for their banking needs. Subsequently, this has put pressure on banking technology to scale to support customers banking from the comfort of their homes. Also, the banking system must allow customers to access all application functionalities they need and be ready for unexpected demand surges. Fortunately, Kubernetes enables innovation and rapid deployment of new services and products to meet this demand. Additionally, it is scalable in nature, meaning that fintech organizations can support a growing customer base and handle peak workloads as they arise.

2. Supporting development and operations

Developers play a vital role in actualizing the vision of consumer support teams, innovators, and product teams. Kubernetes allows development teams to create and deploy microservices in orchestrated containers. The containers permit them to develop and run software applications and systems as a collection of different services organized around the banks' business services. Also, containers package software to support new releases and updates without causing service downtime.

In addition, banks require their systems to be always operational. Hence, they must ensure that system or infrastructure issues, such as lack of access and hold-ups, don't delay developers' operations. Coding is a highly creative process that drives innovation and increases the ability to test new ideas ideal for creating cutting-edge products. Therefore, deploying small, discrete microservices in Kubernetes provides many benefits. It allows developers to understand the functionalities of services quickly, enabling them to iterate and provide business value faster. Developers can also roll out separate functions to the same applications, change the underlying infrastructure, and automate testing without causing system downtime.

Equally important, tracking the infrastructure expenses and preparing for unexpected issues is vital for operations. Principally, scalability determines how well an application or service can handle spikes in load. It is pertinent to ascertain that software applications are not over-or under-resourced since they significantly impact the customers served and the costs incurred in running the cloud infrastructure. Kubernetes shines in this area, allowing fintech companies to scale their applications and underlying infrastructure automatically. In other words, it provides them with the elasticity needed to handle demand while minimizing infrastructure costs.

3. Helps build a robust foundation for banking systems

Trust in the fintech sector boils down to banking applications' security, robustness, and resilience. Security breaches and frequent downtimes can erode customer trust, causing them to look for more reliable alternatives. Luckily, Kubernetes's scheduling capabilities address such issues. Orchestrated containers permit banking institutions to handle issues causing instance downtime, ensure high availability by creating services across multiple data centers, and enable complex network traffic routing to counter the impacts of targeted attacks.

More importantly, banks should ensure that time and innovation pressures do not lead to rushed development at the expense of robust security. With Kubernetes, developers can integrate security in all development aspects to ensure security by design. Various platforms automate this, allowing developers' teams to set up clusters comprising the required security configurations. As a result, it eliminates concerns regarding the security of applications within a banking system.

Fintech organization hails Kubernetes in solving challenges.

German-based Figo, a banking service provider founded in 2012, joined Berlin's Finreach in 2019 to form a SaaS API platform for financial services. The company aimed to create a platform where partners could develop more accessible fintech services and applications for payment and banking services. Also, the platform aimed to provide a singular customer experience where customers can initiate financial transactions, verify bank balances, aggregate and analyze financial sources, read bank data, and initiate transfers.

However, as the service provider expanded and scaled the platform to meet the increasing demands and needs, it encountered technical restrictions and rising costs arising from the VM-based environment. Therefore, Figo addressed the challenges by transitioning to a Kubernetes-based container infrastructure. The factors influencing this decision included the need to reduce complexity, induce highly flexible scalability across the backend infrastructure, and provide customers with a more reliable platform. In addition, Figo wanted a solution that delivered superior operational efficiencies and could deliver security and risk management measures.

Therefore, Figo deployed a bare-metal container infrastructure orchestrated using Kubernetes to provide the applications required for its banking services. As a result, this increased the flexibility of the banking platform. Now,

the new architecture delivers high scalability, performance, and stability. Also, the container-based infrastructure boasts high security by protecting against threats like data breaches and malware attacks. It also relies on the technology to ensure compliance with necessary regulations. In summary, migrating to Kubernetes enabled Figo to address security, performance, and scalability challenges.

Considerations for adopting Kubernetes infrastructure in bank systems

Kubernetes adoption may come with different challenges. Therefore, banks should consider the following factors when migrating to a Kubernetes infrastructure.

1) Budget

Some financial institutions may have more cost constraints than others. Before moving to a Kubernetes infrastructure, an organization should consider the migration costs. The migration process is time-consuming and often requires the input of experts. Furthermore, some organizations may fail to comprehend the expenses of migrating legacy applications and systems to containers. The expenses include the involved human resources and costs for migrating data. In addition, Kubernetes does not restrict the utilization of resources. Thus, developers must consider and understand the best practices in cost controls, such as configuring resource limits, especially at the start of the migration process.

2) Kubernetes skills

Kubernetes skills are an important factor since technology is continually evolving. In most cases, the technology evolves so quickly that teams and individuals may fail to keep up with new Kubernetes functionalities and best practices. Also, in-house teams may have a narrow experience related to the organization's specific use cases, leaving gaps in their understanding of transitioning to a Kubernetes infrastructure. Enterprises with high technical sophistication can use their ability to manage the Kubernetes infrastructure as a competitive advantage, while less sophisticated firms may focus on the application layer.

3) Day 2 operations

Day 2 operations pose a significant challenge to Kubernetes adoption, particularly at the proof-of-concept phase.

Applications running on Kubernetes require maintenance, upgrades, and monitoring during their production phase, which can be complex, time-consuming, and error-prone when done manually. Kubernetes Operators can help automate Day 2 operations, but most Operators are vendor-specific and not mature enough for enterprise production use.

4) Current infrastructure

The type of infrastructure on which Kubernetes will run must be considered. Organizations may plan to run Kubernetes on-premise, in the cloud, or across multiple public clouds or on-premise public clouds. Each environment poses unique challenges that must be addressed.

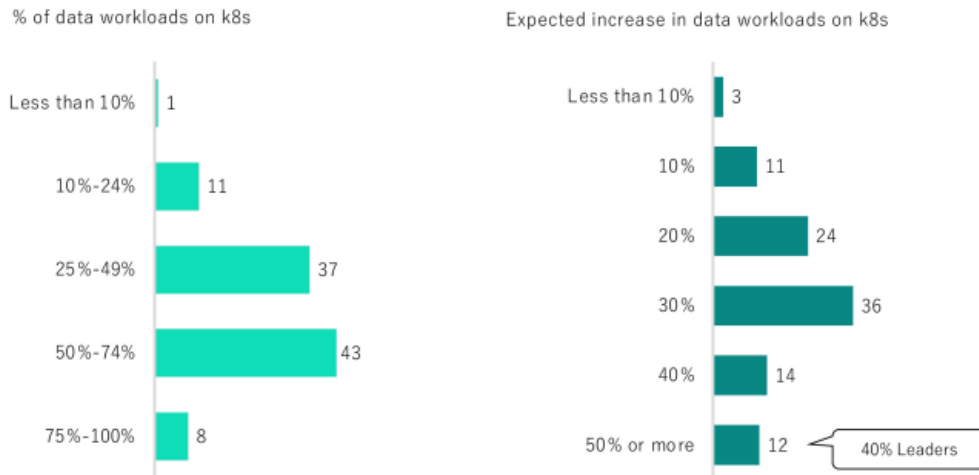
Conclusion

Kubernetes infrastructure is a game-changer for banks and other financial institutions looking to modernize their IT systems. It is also a suitable choice for delivering exceptional customer experiences. In this regard, adopting Kubernetes can help banks gain significant advantages. For example, using a Kubernetes infrastructure to run bank systems can increase scalability, enable faster deployment times, improve resource utilization, and enhance security. Furthermore, Kubernetes provides a reliable and efficient platform through which banks can handle massive amounts of data. Also, a Kubernetes infrastructure supports complex workflows and allows banks to respond quickly to changing market demands.

In addition, Kubernetes' container orchestration capabilities provide easy scalability. Thus, banks can easily scale their applications and services. Additionally, Kubernetes infrastructure ensures high availability. Bank systems must be available around the clock, and Kubernetes infrastructure provides high availability and fault tolerance. Furthermore, the Kubernetes infrastructure offers a robust security framework. According to a Data on Kubernetes 2022 report, a survey of more than 500 international technology leaders and executives found that at least one half of the respondents run more than 50% of their data workloads on Kubernetes, with more to increase in the next twelve months.

DoK workload %s are already high, and expected to increase

Leaders are chomping at the DoK bit



(Left-hand side) Q. What percentage of your organization's data workloads are running on Kubernetes? That is, of the total number of data workloads your organization is running, what percentage of them are running on Kubernetes?
 (Right-hand side) Q. By how much do you expect your organization's percentage of data workloads run on Kubernetes to increase in the next 12 months?

Figure 3: Organizations set to run more data workloads on Kubernetes

However, deploying and managing Kubernetes is a complex process. Therefore, banks must carefully plan and implement their Kubernetes strategies to achieve the desired results. For example, need the right expertise and tools to implement and manage their Kubernetes environments effectively. Such tools include automated deployment and management, monitoring and logging, and security.