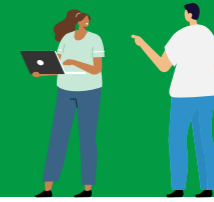




CI/CD for the Hybrid Cloud





The story of cloud computing often focuses on the cloud as a disruptive technology that burst onto the scene, forcing old methods aside. While the cloud's role in rapidly catalyzing changes is an exciting tale, it fails to acknowledge an essential truth about cloud infrastructure: much of it is only partially "in the cloud."

From its earliest days, cloud computing has been combined with on-premises computing capabilities in an approach called the hybrid cloud.

Hybrid cloud strategies enable organizations to complement their existing on-premises deployments with cloud capabilities. Hybrid setups can also be a stepping stone for a gradual transition from on-premises to full-cloud architectures.

The hybrid cloud model introduces some unique challenges that teams never face in purely on-premises or full-cloud strategies. As hybrid architecture complexity increases, so does the difficulty of ensuring compatibility across services and coordinating DevOps teams. One way to address these challenges is with help from modern continuous integration and continuous deployment (CI/CD) toolkits that assist teams with development and deployment.

This whitepaper examines the hybrid cloud in more detail, including its benefits and use cases. Then, it explores how CI/CD tools help work with these mixed environments.





What is a hybrid cloud?

Modern IT infrastructure fits into two broad categories:

On premises

These solutions rely on hosting vital infrastructure, such as servers and data centers, at a company-managed location.

Cloud

Third-party companies provide cloud infrastructure solutions hosted off-premises. Cloud services are either public or private. Public cloud services are offered as a product to the public at large. Private clouds are configured for an organization's specific needs and are not available to others.

A hybrid cloud is an IT infrastructure comprising some combination of on-premises and cloud solutions. Hybrid cloud architectures often incorporate any number of public and private cloud services with on-premises infrastructure deployed at one or more physical locations the organization operates.

Traditionally, software companies would select a single type of infrastructure to deploy their monolithic applications. This method made sense for the large self-contained applications that were once commonplace. A company might provision several servers on premises to run an application or select a specific cloud provider to handle the deployment.

As distributed computing became widely available, software development left behind the old methodologies that created monolithic applications in favor of microservice architectures. The division of software into discrete units (containers and microservices) triggered the rethinking of how software deployments leverage cloud capabilities.

In the past, a hybrid cloud architecture would necessitate complex and expensive middleware layers to enable monolithic applications to communicate. Monolithic applications are supposed to be self-contained, while microservices are supposed to communicate with one another. By removing the need for complicated middleware, modern microservice-based software is far more flexible in its ability to interface with other services and far more agnostic in its reliance on specific architectures.

This new design and deployment philosophy invites developers to experiment with hybrid architectures that combine multiple cloud providers and on-premises solutions. When teams are willing to tackle the complexities of the hybrid cloud, they position themselves to take advantage of the full spectrum of deployment technologies.





Benefits of hybrid cloud architecture

Hybrid cloud architectures allow developers to select the best solution for their deployments on a service-by-service basis. Engineers can carefully choose the best infrastructure for each microservice to optimize their deployment efficiency, weighing factors like cost, security, and infrastructure control.

Enhanced security

While many cloud providers boast about their state-of-the-art security, the cloud inevitably introduces numerous security concerns. Cloud services ultimately require some level of communicating and storing data that is not under the organization's complete control. This situation is unacceptable for specific industries dealing with sensitive data and applications.

On-premises architecture offers a higher degree of control over infrastructure and the data it handles, but it comes with the burden of providing your own security solutions. Providing in-house security is a desirable feature for sensitive applications but can prove unnecessarily expensive when security is less of a concern.

Hybrid cloud architecture enables companies to secure sensitive data using on-premises services while still taking advantage of the cost-saving potential of deploying to the cloud for services that don't require additional security.

Improved flexibility

Cloud solutions are more flexible than their on-premises counterparts. Resources are easy to come by in the cloud, and developers can quickly provision them without worrying about physical hardware. Developers can rapidly provision or decommission servers and environments using nothing but their command line.

Although modern on-premises solutions use virtualization and containerization tools to replicate many of the cloud environment's features, few businesses have the raw computing power to compete with top cloud providers. Significant changes to on-premises infrastructure often necessitate physical interaction with the hardware or installing new hardware to expand capabilities.

With a hybrid cloud model, businesses can leverage the flexibility of the cloud while maintaining maximum control over their on-premises services. Engineers can provision resources from the cloud when necessary and move services on premises if they are not making good use of cloud capabilities.

Unlimited customization

The core benefit of an on-premises solution is unlimited customization. With complete control over the physical hardware and the software it runs, developers can create completely custom environments. This freedom enables teams to truly push their application's capabilities to the limits of available technology.

While many cloud providers offer an extreme degree of customization for their services and provide developers a high level of control over the environment, the cloud provider ultimately controls the infrastructure, limiting the extent of possible customization.

A hybrid cloud enables developers to deploy their microservices to the most suitable location. On-premises architectures can host services best optimized through customized infrastructure while less-demanding services run in the cloud.

Reduced costs

On-premises infrastructure requires substantially more initial investment to set up than cloud infrastructure. Despite that, for businesses operating at a large enough scale — or running exceptionally complex infrastructure — on premises can sometimes offer more savings than cloud solutions.

It is often cheaper to **start** using cloud services. But over a long enough period, the costs of cloud versus on premises have to be compared by organizations on a case-by-case basis, as significant increases could occur. Comparing the two helps to determine the most cost-effective solution.

Hybrid cloud architecture minimizes the burden of operating your entire deployment on premises or in the cloud. Companies can weigh the cost of running individual services on-premises versus in the cloud, reducing expenses by using the most cost-effective resources for each service.

Regulatory compliance

Specific industries must comply with strict legal requirements when handling data. Government, healthcare, and banking are among the applications that demand high levels of security and customization while requiring diligent compliance.

Cloud providers often cannot meet these requirements. In some circumstances, handling data on the cloud may simply not be an option. Compliance frequently drives businesses to create on-premises solutions, which are the only way to keep pace with regulations reliably and ensure sensitive data is locked down.

Hybrid cloud architectures enable businesses to operate their services compliantly using on-premises solutions, while still leveraging cloud providers for services whose compliance requirements are less stringent.



Requirements for hybrid cloud architecture

Establishing a hybrid cloud architecture requires infrastructure, staff, and a detailed plan for integrating various services.

Basic requirements for a hybrid cloud include:

Location and hardware

You need a physical place to host a data center comprising your on-premises servers. Physical assets are often the most expensive part of a hybrid cloud deployment, as on-premises requires buildings, electricity, and hardware, among other expenses.

Personnel

Setting up and maintaining an on-premises data center requires system administrations, network architects, technicians, and other IT staff to manage hardware. Depending on what services are deployed on premises, you may also need specialist staff such as engineers and database administrators.

Cloud providers

One or multiple public or private cloud platforms may provide any resources not available on premises. Many hybrid cloud architectures interface with numerous public and private cloud providers.

Strategy

You should create a detailed technical plan outlining how your architecture divides between on-premises and cloud solutions.



Hybrid cloud use cases

Uses for hybrid cloud architectures can be highly generalized or extremely specific. One of the most common uses is cloud bursting, a strategy for handling resource overflow. This method complements on-premises systems by directing traffic spikes and unexpected load to easy-to-provision cloud resources, maintaining on-premises resource stability.

Other applications such as big data analytics rely on cloud computing to perform resource-intensive tasks, like accessing transactional databases, without slowing critical on-premises infrastructure.

With cloud resources at their disposal, developers have the freedom to experiment. Developers can run parallel tests in the cloud, spinning up as much compute power as they need and discarding it after the test is complete, all without affecting on-premises infrastructure performance. Software testing in the cloud ensures only well-tested code makes its way to on-premises hardware.

When custom solutions are necessary, on-premises infrastructure provides complete control over software and hardware as well as physical access to machines. When they operate in concert with cloud resources, on-premises solutions minimize costs by limiting their operations to only services the cloud cannot handle. Rather than running an entire data center, an organization may handle its on-premises needs with just a few servers and a hybrid cloud strategy.

Industries leveraging hybrid cloud architecture

Hybrid cloud architectures have become commonplace throughout a variety of industries. The hybrid cloud's unique capabilities are well-suited for industries requiring high volumes of computing resources while simultaneously maintaining high security levels and managing privacy concerns that necessitate on-premises infrastructure.

Hybrid cloud's most common uses include:

Startups

Tech startups often create extremely demanding and resource-hungry applications. For cutting-edge technologies requiring specialized hardware (such as artificial intelligence applications), on-premises solutions are often more affordable, flexible, and capable than cloud infrastructure. Startups with extreme infrastructure demands can employ low-cost cloud resources for less resource-intensive services while building robust on-premises architecture for core capabilities. These companies synergize the two solutions with a hybrid cloud strategy.

Enterprises

Enterprises are often home to legacy applications that cannot operate in the cloud. Employees must maintain these applications on premises using existing infrastructure. Maintaining legacy applications has traditionally been a barrier to modernizing infrastructure. However, with hybrid cloud architectures, enterprises can preserve their legacy systems while still using modern cloud capabilities for other services.

Finance

The financial industry places extreme demands on its infrastructure's security and performance. Leveraging hybrid cloud deployments allows financial tech companies to access vast resources in the cloud while maintaining high levels of security and complete control over their mission-critical infrastructure.

Healthcare

IT infrastructure in the healthcare industry needs to handle sensitive patient data in compliance with local laws. This requirement often necessitates on-premises solutions for managing sensitive data that cloud providers cannot process. With healthcare providers and patients increasingly relying on digital tools, the healthcare industry places unique demands on infrastructure. Hybrid cloud architectures are ideally suited to meet these demands.

Government

Government applications must often handle extreme traffic, store and transmit sensitive data, and support vital infrastructure. Leadership often places lofty expectations on these systems' uptime and accuracy. Hybrid cloud architectures allow governments to secure sensitive information on premises while accessing plentiful cloud resources for traffic spikes and particularly demanding applications.





CI/CD on the hybrid cloud

Continuous integration and continuous deployment (CI/CD) is a strategy for rapid software development assisted by automation. Developers working in the CI/CD model commit small portions of code. Tools automatically test this code before committing it to shared project repositories.

CI/CD enables development teams to collaborate on large-scale software, automatically integrating changes from dozens or hundreds of developers contributing to a project. This strategy has become a driving force in software development to deliver changes rapidly and maximize developer collaboration efficiency.

In the hybrid cloud, CI/CD tools and techniques play a pivotal role. The CI/CD method of small, gradual changes vetted by automated testing lends itself perfectly to complex environments with multi-cloud deployments. With the right CI/CD strategy, developers can operate even the most complex hybrid cloud deployments using the same methods and tools to navigate a full-cloud or on-premises environment.

Automated tools such as CircleCI enable the CI/CD process. CircleCI handles the details of automatically tracking, testing, and deploying developers' code as they commit it to repositories. CI/CD techniques work in the cloud using hosted CI/CD services or run as your self-hosted instance of the CircleCI software.

Hosted CI/CD services allow developers to begin taking advantage of CI/CD almost immediately. By removing the need to set up or maintain your own CI/CD infrastructure, hosted solutions often become the most cost-effective choice, as they allow businesses to pay only for the CI/CD features they use without the overhead of creating an on-premises solution.

However, hosted services can pose drawbacks for organizations that want more control over their infrastructure. Hosted CI/CD cannot access data inside private company networks, limiting its utility during integration testing.

In contrast, self-hosted CI/CD provides complete end-to-end control over code, data, and infrastructure. However, with this extra control also comes the additional cost of setting up and maintaining your own CI/CD infrastructure.

Hybrid cloud architectures capture the best of both worlds. Development related to sensitive data and services can take place entirely on premises, allowing your CI/CD pipeline to integrate seamlessly across the hybrid cloud without compromising delicate systems. Self-hosted runners enable you to select which jobs run on premises and which run in the cloud, allowing the organization to perform CI/CD on sensitive data without jeopardizing security.





Creating your hybrid cloud CI/CD pipeline

CircleCI offers a variety of options for configuring your hybrid cloud. With the option to operate your CI/CD pipeline on CircleCI's hosted cloud or install the CircleCI software on your own infrastructure, you can select the level of control and flexibility best suited to your business.

CircleCI's hosted plans are an easy way to add a cloud-based CI/CD pipeline to a hybrid cloud architecture since they can perform concurrent jobs, provide self-hosted runners, and access substantial computing resources for testing code. Hosting CI/CD in the cloud eliminates the need to set up servers on premises specifically to handle CI/CD and provides access to CircleCI's dedicated support staff.

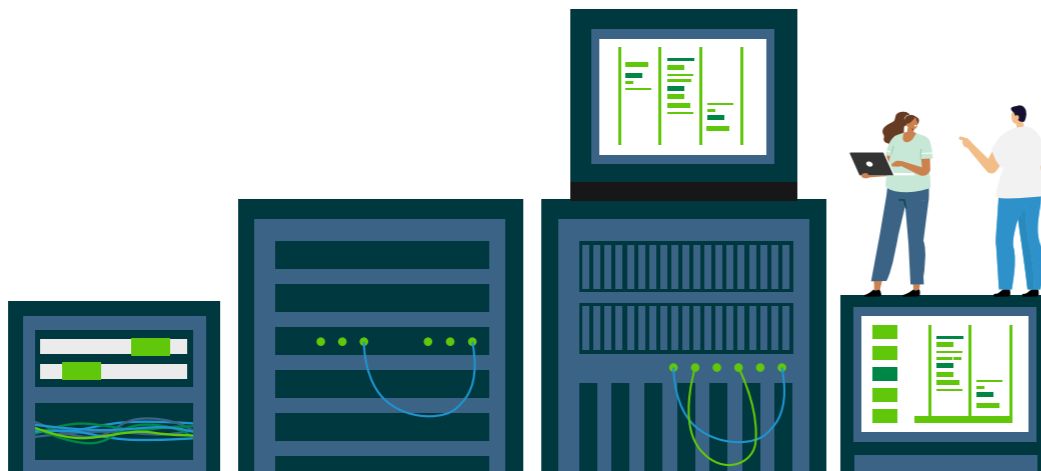
Setting up CircleCI's cloud-based CI/CD pipeline is as simple as connecting the appropriate GitHub or Bitbucket repositories to your CircleCI account. Each time it detects a code change, CircleCI spins up a virtual environment to run tests, then sends the results of those tests via chat, email, and web notifications.

For organizations looking to maintain control over their CI/CD pipeline, CircleCI server can run on your own infrastructure, bringing all the benefits of CircleCI into your controlled private environment. An self-hosted CI/CD pipeline requires the overhead of setting up and maintaining servers dedicated to running CircleCI. However, it also provides the benefit of keeping all code and data safely within your private network infrastructure.

While CircleCI functions much the same on premises as it does in the cloud, configuring your CircleCI installation and self-hosted CI/CD infrastructure requires setting up hardware, installing CircleCI server software, configuring system resources, and connecting to your GitHub or Bitbucket code repositories. Though the initial setup is more involved, CircleCI can provide all its benefits and features once running on your infrastructure.

With CircleCI's cloud-based Scale plan, enterprise organizations can take advantage of unlimited self-hosted runners. Self-hosted runners enable teams to execute specific CI/CD tests on their infrastructure while still operating most of their CI/CD pipeline in CircleCI's cloud. This approach provides extra flexibility for hybrid architectures and opens new options for configuring hybrid clouds.

Rather than attempting to bring the entire CI/CD pipeline either on premises or in-cloud, self-hosted runners enable hybrid deployments to extend their CI/CD pipeline to their infrastructure's full breadth.





Make the most of hybrid cloud architecture

Hybrid cloud architectures combine the security and customization of on-premises with the flexibility and affordability of cloud deployments. With microservice architectures inviting a new paradigm in deployment strategies, software companies are increasingly diversifying their deployment technologies, often incorporating multiple public and private cloud solutions with on-premises infrastructure.

The hybrid cloud model is likely to be a staple of software deployment for some time. Easily adaptable to various everyday situations, hybrid clouds help on-premises architectures scale and help cloud services optimize performance and security.

Creating a hybrid cloud architecture requires substantial planning and overhead. With hybrid cloud strategies often representing the most complex deployment methods, automated tools such as CircleCI play a vital role in creating and maintaining the hybrid cloud.

Using CircleCI, developers simply commit their code to repositories using familiar tools such as GitHub. CircleCI's automated CI/CD pipeline then handles testing the code and deploying it to the proper location in the architecture. All developers need to worry about is programming.

Want to explore the potential of adding CI/CD to your hybrid cloud architecture? [Sign up](#) for CircleCI and experience firsthand how it simplifies development in even the most intricate hybrid deployments.