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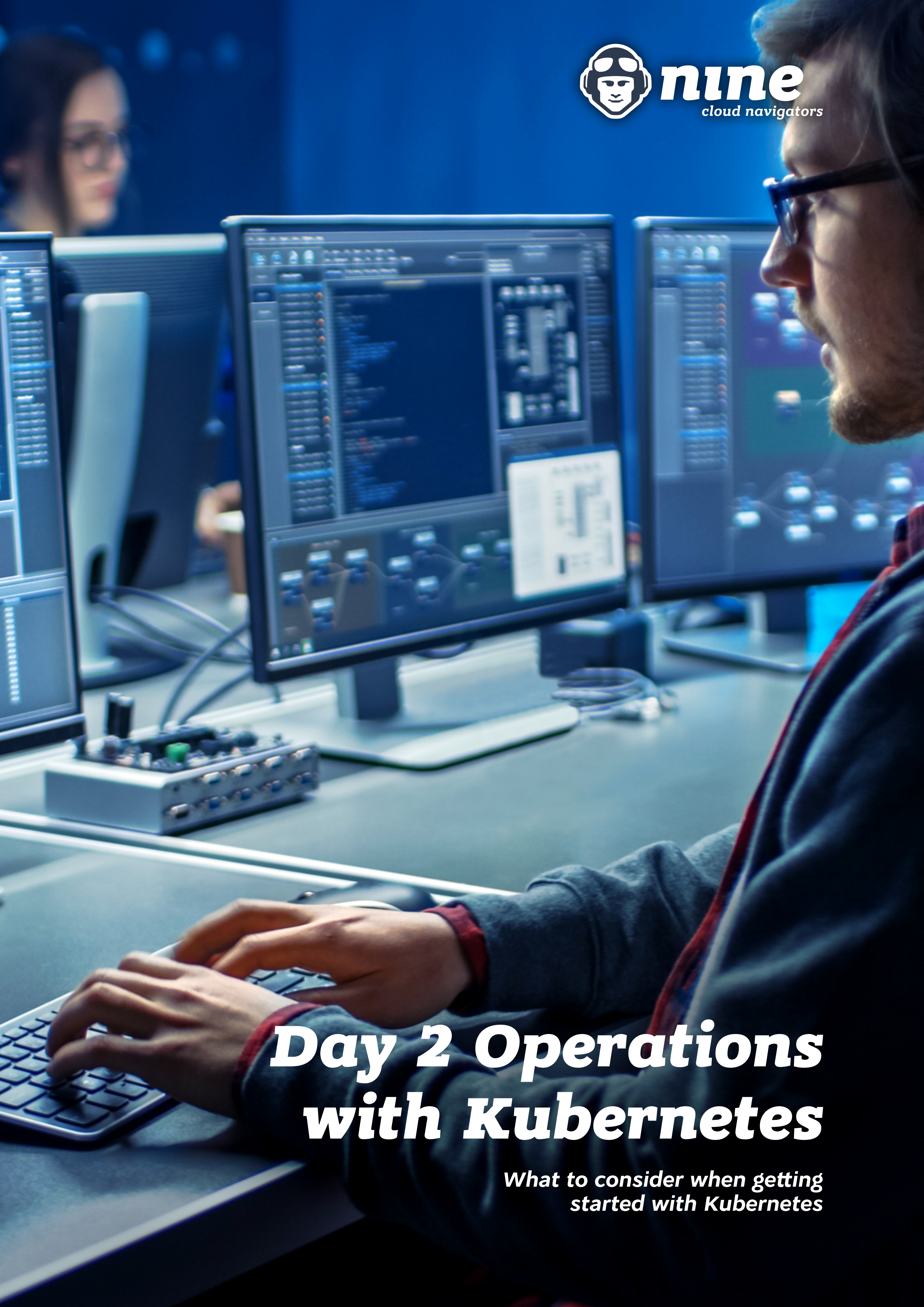

Day 2 Operations with Kubernetes

What to consider when getting started with Kubernetes

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Day 2 Operations with Kubernetes

Kubernetes: An Open-Source System on the Way to Becoming the New Standard

In next to no time, Kubernetes has developed from a niche technology to the world-wide de-facto standard when it comes to efficiently providing, scaling and managing containers. More than 5.5 million people[1] in software development rely on the open-source system to publish features and functionalities faster, and to operate highly-customisable IT infrastructures. In deployment and container orchestration, Kubernetes provides users with tremendous advantages: applications and components are available 24/7, without interruptions or lost transfers.

Successful Implementation of Day-2 Operations

When introducing Kubernetes to their own IT systems, many companies are soon faced with a major challenge: day-2 operations. This is the point where the product is ready for use and is set to be integrated into their daily business. Maintenance, monitoring and optimisation tasks arise, and from this moment onwards, if not before, they require continuous resources. This is why businesses should make resources and internal know-how available early on to ensure that implementation and the transition to using Kubernetes in their daily business go as smoothly as possible. Since day-2 operations do not end with a successful "day 2", but last for the entire product life cycle, long-term thinking is needed. This is because only continuous system analysis and patching create efficiency when running applications in Kubernetes.

This whitepaper presents useful tips on which processes you can expect when implementing Kubernetes, what you need to consider, and how you can manage functionalities sustainably with the right tools.

Happy reading!

[1] Cloud Native Computing Foundation (CNCF) Annual Survey 2021

Adopting Kubernetes in Your Business

Businesses are actively looking for options which allow them to optimise their software architecture and future-proof it at the same time. Integrating containerised applications is one such option. Kubernetes is frequently used as a framework in this context to manage applications in a standardised manner. Although the open-source system is known to have great potential and to have revolutionised the IT world, its real-life implementation is often quite complex. **Running Kubernetes requires a new working mode**, as familiar workflows have to be disrupted and adapted. If you have already experienced change within a company, you know how long such processes can take. This is because, aside from the process-related change, a change in the workforce needs to be initiated as well: the usefulness and goals of the new working methods must be transparent and understood to enable a transition across all departments.

Actively Implement the Change Process and Think into the Future

Many tasks necessary in Kubernetes-related workflows are not covered by Kubernetes itself. Thus, businesses need to be aware that further tools are needed – and that these also need to be met with acceptance and understanding among the workforce. When all factors are considered right from the beginning, an overly long change process can be avoided and the full potential offered by Kubernetes can be harnessed sustainably.

The challenges a company may face relate to several areas:

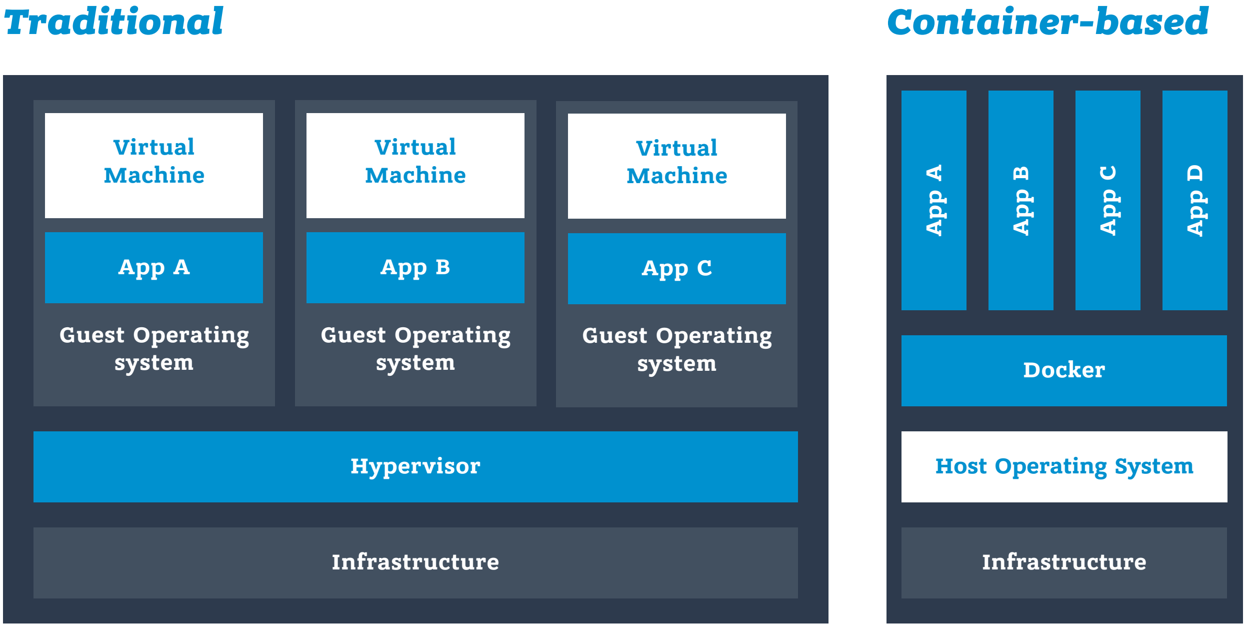
- finding qualified personnel who are already experienced and have a basic understanding when it comes to implementing Kubernetes and its long-term impact,
- developing an exact plan concerning the tasks related to day-2 operations,
- creating and maintaining an overview over the timeframe and cost involved.

Containers and Kubernetes: Increasing Velocity

Instead of focusing on their core competencies and engaging in value creation, companies often spend much time ensuring that their applications simply run. However, in software development, fast processes play an important role – to be ahead of the competition, provide users with a first release, or to receive feedback regarding bug fixes early on. Kubernetes enables a largely automated process – as long as there is a managed cluster and the application is configured correctly. This means that cost is kept to a minimum, **iterations are shorter, and time to market is significantly reduced.** Aside from ensuring a happy IT department, this also leads to more customer satisfaction in the long run.

Containers: Strong Software Packages

Due to the ever more complex nature of applications, the responsibilities of IT departments are increasingly growing, the complexity of application architecture, frameworks and environments is rising. Containers can help, since developers can define the software runtime environment, which is abstracted from the underlying infrastructure. When providing containers, the applications and all related components are packaged. The upside: **applications are less dependent on their environment**, and can be run at any time and on different hosting systems. In order to benefit from these advantages, what is needed is container orchestration – and thus the use of a system like Kubernetes.



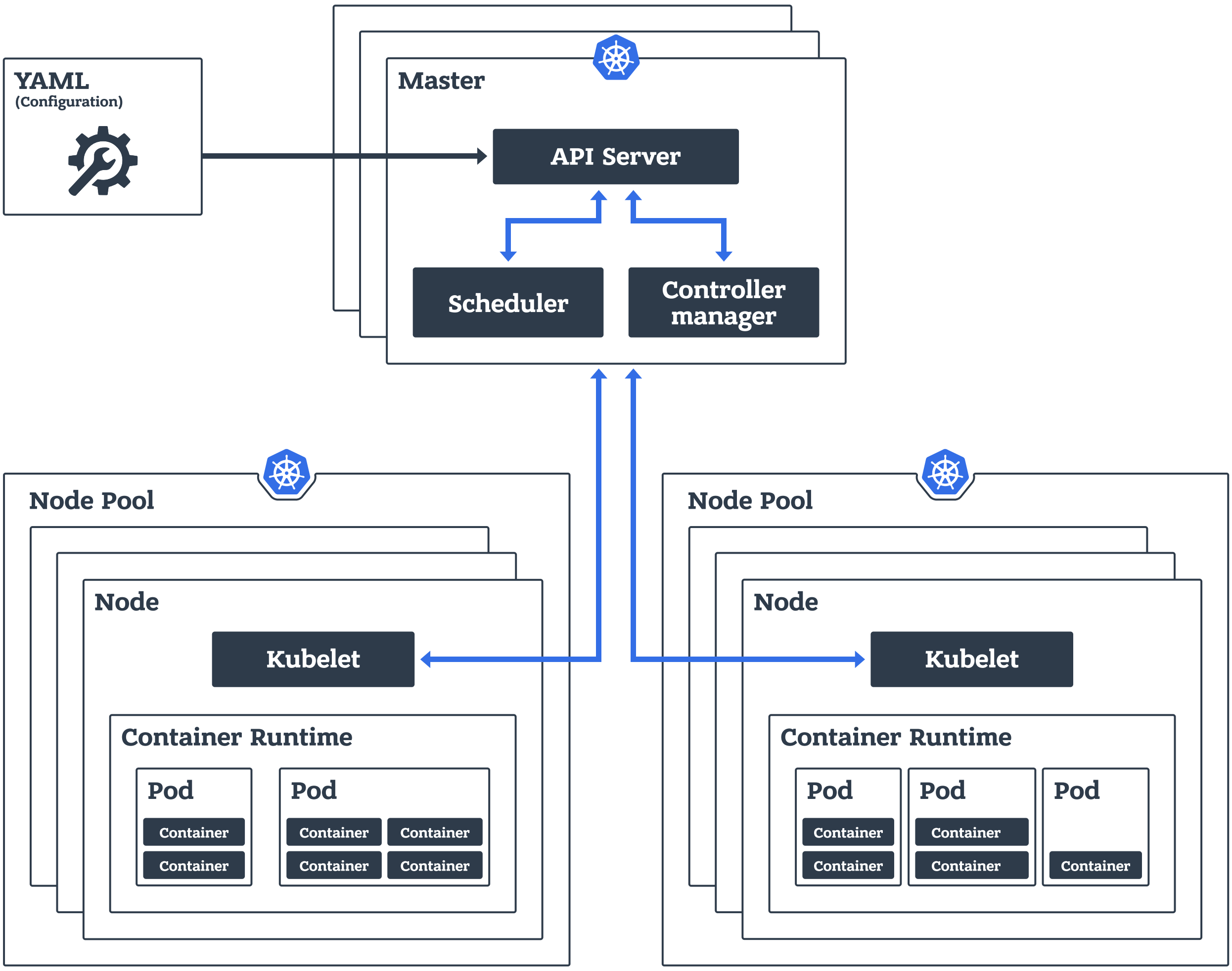
Traditional versus container-based deployment

The advantages of containerised applications

- more efficient workflow
- lower work expenditure
- less storage used and reduced need for resources due to higher application density
- testing and production environments are assimilated

Kubernetes: A Short Explainer

The open-source system Kubernetes allows for the management and orchestration of containerised workloads and services. In addition, Kubernetes does not only coordinate computer and network infrastructures, but also the infrastructures for user workload storage, providing a container-centric management environment. Its advantages and strengths become particularly apparent when it comes to automating processes. Here, it works as an ecosystem which acts as a central access point for components and tools. This allows for easier roll-out, scaling and management of applications. Additionally, with the help of scalable architecture, containers can be orchestrated across several machines — anytime and anywhere.

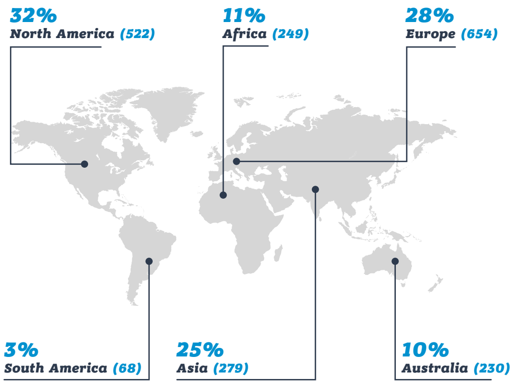


Simplified Kubernetes architecture

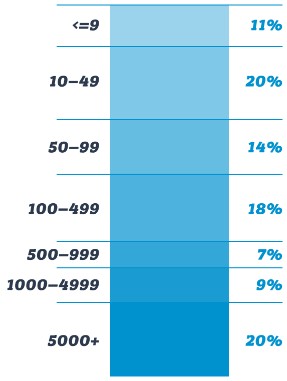
Kubernetes in Business: A Valuable Technology for Companies

Due to the increasing prominence of Kubernetes around the world, the open-source system can be found in the IT departments of businesses of any size. These companies benefit from the flexibility of being able to adapt and customise Kubernetes, and they use this to drive innovative projects and to tackle the growing challenges when it comes to monitoring and communication.[2]

Regions



Company Size



Kubernetes is increasingly being used worldwide

What Are the Advantages of Using Kubernetes?

A shorter time to market

Opting for Kubernetes and containers leads to homogeneous development, testing and production environments. This actively supports deployment automation, thus new releases can be published faster.

Improved portability

Applications in containers can be managed via Kubernetes independently of their environment. The ability of Kubernetes to deploy containers regardless of the underlying infrastructure provider means applications can run in geographic proximity to customers and avoids vendor lock-in.

[2] Cloud Native Computing Foundation (CNCF) Annual Survey 2021

Lower costs through re-usability

One major added value of Kubernetes is that components and stacks can be re-used. Instead of building them from scratch every time, the IT department can rely on existing **containers and configurations**, often packaged as helm charts, and adjust them accordingly. This saves time and money, and creates efficient workflows.

Aside from financial advantages, Kubernetes also provides companies with technical benefits:

More stability and higher availability

Through automation, Kubernetes supports companies in decreasing expenditure. By automating processes that not only validate code quality but check Kubernetes configurations, scan for container and code vulnerability, data leaks etc. it is easy for an engineering team to understand potential implications of changes made to their codebase. A number of tools which are highly integrated with Kubernetes also make it easy for engineering teams to optimise their incident management processes by integrating dashboards, metrics, log observability and alerting platforms.

Horizontal scaling and load balancing

Using a container orchestration system enables a higher resource utilization, since workloads can be scaled and distributed horizontally across several servers. Automated scaling leads to optimal resource planning, while service availability can be maintained during traffic peaks. At any particular point in time, only those resources which are needed are actually used.

De-coupled application and operating system

As the interface between container and operating system is well-defined, it is generally of no consequence which underlying version of which particular Linux distribution is used. This means that the operating system can be updated or even exchanged without affecting the containers.

The Kubernetes Application Lifecycle

The transition to Kubernetes and container-based applications brings long-term change to well-known procedures. To create a holistic environment, in which real and sustainable success can be seen, the change process has to be planned and implemented correctly right from the beginning. The process itself can be broken down into two phases:

CI/CD (Continuous Integration/Continuous Deployment)

Continuous Integration (CI)

Complex processes are needed for a new code version to make its way from a local machine to a cluster in the cloud. From a technical perspective, pipelines need to be in place to ensure that all automated tests work successfully. After that, container images have to be built, while the Kubernetes configuration needs to be patched. From a business perspective, A/B testing can be helpful, roll-outs can be restricted to specific regions, or certain features can only be made available for particular user groups.

All of these requirements demand a complex environment with the ability to be adjusted on an ad-hoc basis, which is additionally supported by the right toolset. Ideally, the entire continuous integration (CI) process should run in the background, while the necessary changes are pushed to one central place via a version control system (VCS). Meanwhile, the CI system is automatically activated to test the amended code in a production-like environment. Kubernetes containers should be seen as immutable and their contents should not be changed at runtime.

This represents a strong deviation from traditional deployment methods, as new versions of an application are simply uploaded to the server and activated. The advantage here: container images ensure that the container in the CI pipeline is identical to the one in production.

Continuous Deployment (CD)

CD presents a continuation of CI, as new versions are continuously published. The software is being continually updated without the need for a maintenance window. In practice, this step is often not easy, since it does not only require a robust CI phase to build on, but also the acceptance of those who are responsible for the application. Here too, the chosen toolset is of great importance to ensure users do not face disruptions and the process can run without manual intervention.

Observability

With a fully automated testing and deployment pipeline in place, the process can move on to the observability phase.

Continuous, but small improvements ensure availability

Smaller quality improvements are now undertaken, such as monitoring the application to identify outages early on and provisioning necessary items such as TLS certificates. To inform users about possible regressions after a deployment, Kubernetes provides several metrics. Here, it is important to start by finding out which areas are being monitored and how to react to unusual performance. Service Reliability Engineering (SRE) is based on the idea that service availability is a prerequisite for success. Companies should therefore know what has a noticeable impact on their users. To ensure this, Service Level Indicators (SLIs) as well as Service Level Objects (SLOs) are defined and implemented via monitoring and the alerting system. This allows for the creation of an error budget which defines how many outages or other service disruptions are acceptable. With Kubernetes, applications can be scaled intelligently on the basis of metrics. While adjusting CPU and memory is possible right from the start, additional tools allow for the use of further metrics.

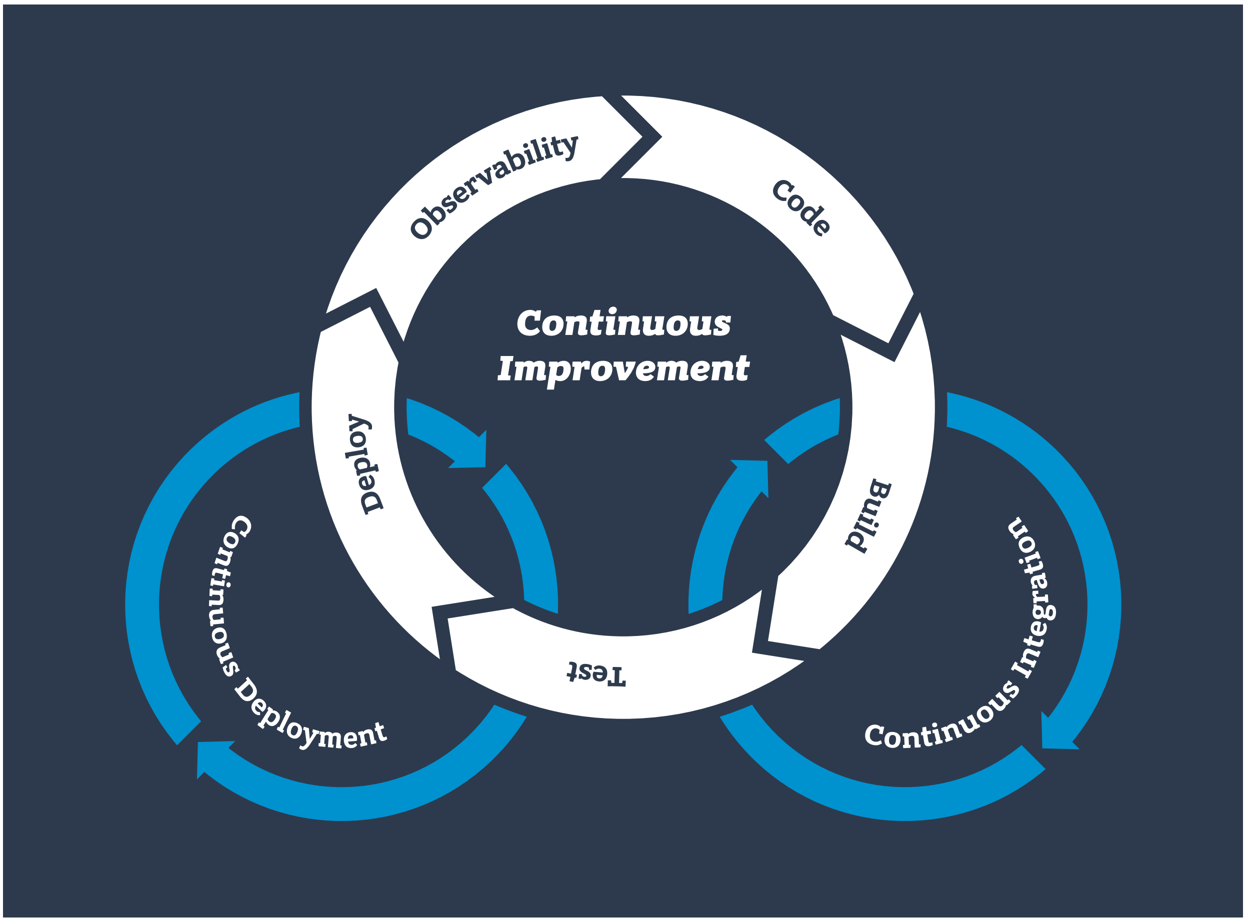
Automatic re-starts mitigate small bugs

Automatic re-starts make sure that non-critical bugs may be mitigated until they are fixed. However, to enable this, the application's performance profile needs to be defined in advance. Once it is clear how the application performs when faced with traffic peaks, and how much CPU and memory are required, suitable limitations can be set. This means that infrastructure cost can be better controlled. At the same time, service quality is kept at a steady level for users.

Disaster recovery creates security

While Kubernetes is able to absorb certain outages within the underlying structure, companies should rely on disaster recovery to have a back-up plan in case an entire cluster becomes unavailable due to a configuration error or a larger outage. Having cluster configurations and data backed up is an important prerequisite. Here too, additional software is necessary to automate back-ups, transfer them to a different location and store them for a certain amount of time.

[3] Error budget = maximum amount of time a technical system can fail without contractual consequences. In SRE setups it is expected that if an error budget is reached the technical team will immediately refocus their work on platform and application stability over additional feature development.



Application lifecycle phases when running Kubernetes

In traditional development, maintenance windows are used to collect changes, implement them and then publish a new release, generally every quarter or so. There are multiple disadvantages to this, however. The large number of simultaneous changes makes it difficult to accurately allocate errors, and the waiting period for new features bug fixes is much longer. When rolling out smaller, but more frequent updates, this is alleviated. Errors can be fixed during business hours in a faster and more efficient manner.

Implementation: What Companies Need to Consider

Implementing Kubernetes is complex – as shown in the chapters above, particularly in the description of the lifecycle phases. Nevertheless, the growing popularity of Kubernetes shows that it is worth the effort. Yet, thorough preparation is an absolute necessity to ensure that you do not lose track of your goals in the implementation phase. The following points can help you prepare:

Checklist: Preparation Tips

Demand management

What are the requirements for the transition to and the new work process associated with Kubernetes? What are the necessary technical prerequisites for the implementation process?

Workflow consulting

How can a successful workflow be achieved?

Running Kubernetes and lifecycle management

What are the steps needed for the product lifecycle, and how can they be implemented?

Tool choice

What additional tools are necessary to ensure optimal functionality for both the containers and Kubernetes? Are further services needed?

Running additional services

What does monitoring the systems look like, and who is responsible for it? Who ensures uptime and takes care of the comprehensive lifecycle management, including updates and renaming or replacing tools? Can Managed Kubernetes ease the burden here in a meaningful way?

Optimisation measures

The ecosystem regularly offers new features and tools. Who is responsible for maintenance and updates?

Why Finding the Right Software Tools Matters: An Overview

When running Kubernetes, many other actions are required for a successful synergy. In particular, tasks such as monitoring and the regular maintenance of Kubernetes clusters represent an enormous expenditure for companies, and should not be taken too lightly when implementing Kubernetes and containerised applications. Clusters should be managed well, as even small adjustments such as scaling should not be made without sufficient knowledge. If the necessary expertise is missing, companies who run Kubernetes may in the worst case face additional costs or performance losses.

Functions needed to run Kubernetes successfully

- **The ability to monitor metrics** to keep an eye on your application 24/7 and to find out whether it performs within set boundaries. In addition, the ability to fine-tune Kubernetes configurations is a necessity, as are export options.

- **A robust logging system** to display logs from earlier container runs, save logs in one central place and correlate them with metrics.

- **A scaling tool** which offers additional scaling options based on CPU and RAM (standard metrics in Kubernetes) and allows for adjustment based on a variety of sources, such as database query results.

- **Reliable certificate management** to automatically provide SSL certificates, which allows for automated Let's Encrypt certificates for Ingress.

- **A complete cluster back-up** to ensure that in an emergency, such as a disaster recovery situation, saved data and cluster configurations can be exported and saved elsewhere.

- **Active monitoring** to take the right measures when IT problems occur. When partnering with a service provider such as Nine, the partner takes care of these tasks for you.

- **Regular cluster updates** to avoid faulty configurations, outages or other problems. Many updates contain essential changes – which also need to be monitored, and the IT team needs to be informed about them early on. When entering an IT partnership, these tasks are taken on by the service partner, who will ensure a professional system update.

Experienced service providers support companies when implementing and running Kubernetes

To make sure you never lose track when running Kubernetes and containers, IT partnerships with experienced service providers like Nine can be just the right fit. Experienced experts support you in your transition to container orchestration technologies and ensure that all systems and functionalities work as expected on a day-to-day basis. Such partnerships do not only reduce expenditure, but also cost, as no lengthy experimentation is needed. Instead, an efficient and well-practised working method is used. In addition, the experts can offer highly customised Managed Container Solutions as well as Managed Services around servers, the cloud, containers and clusters.

Nine also offers targeted workshops to companies which explain the basic concepts of Kubernetes and containers, and give an overview of the entire ecosystem – from the creation of a cluster to releasing an application. Here, qualified IT personnel who want to see the benefits of high-end Kubernetes clusters receive the necessary know-how.

Conclusion

For businesses, running Kubernetes initially means thorough preparation and planning. This includes identifying all potential problems surrounding the software release pipeline, as well as questioning who will be responsible for both application and platform runtime monitoring once Kubernetes is in use. After all, as this whitepaper shows, running Kubernetes comes with a high degree of complexity. To implement it successfully in the long run, companies should consider making the necessary resources available early on. Many companies rely on a trustworthy partner and service provider who can support them during implementation as well as day-to-day operations, and who can take on tasks which are not directly related to their value-creating core business. This ensures that they can continue to focus on the development of their own applications while following cloud-native best practices without the added burden of running additional services which are critical for their daily business.

Would you like to find out more about how you can introduce Kubernetes successfully in your business? We are happy to answer any questions you may have.

About Nine Internet Solutions AG

Nine is the leading provider of managed service solutions in Switzerland and offers full platform management in the public and private cloud, both of which use the Swiss location. The company is ISO 27001 and ISO 9001 certified and employs around 40 people. Websites such as mobiliar.ch, jungfraubahnen.ch and geschenkidee.ch are operated in public clouds as well as two Nine data centers in Switzerland. Nine stands for highest availability, highest performance, 24/7 monitoring and full scalability.

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