**19**

**Introducing AIOps and GreenOps in Multi-Cloud**

**AIOps** stands for **Artificial Intelligence for Operations**, but what does it really mean? AIOps is still a rather new concept but can help to optimize your multi-cloud platform. It analyzes the health and behavior of workloads end to end—that is, right from the application’s code all the way down to the underlying infrastructure. AIOps tooling will help in discovering issues, thereby providing advice for optimization. The best part is that good AIOps tools do this cross-platform since they operate from the perspective of the application and even the business chain.

This chapter is an introduction to the concept of AIOps. The components of AIOps will be discussed, including data analytics, automation, and Machine Learning (ML). After completing this chapter, you will have a good understanding of how AIOps can help in optimizing cloud environments and how enterprises can get started with implementing AIOps.

We will also discuss a new concept in cloud operations, which is focusing on sustainability. With the enormous growth of the cloud, we have to be aware that the cloud uses data centers all over the world. These have an impact on our environment. GreenOps makes us conscious of the usage of the cloud in the most environmentally friendly way.

In this chapter, we’re going to cover the following main topics:

* Understanding the concept of AIOps
* Optimizing cloud environments using AIOps
* Exploring AIOps tools for multi-cloud
* Introducing GreenOps

**Understanding the concept of AIOps**

AIOps combines analytics of big data and ML to automatically investigate and remediate incidents that occur in the IT environment. AIOps systems learn how to correlate incidents across the various components in the environment by continuously analyzing all logging sources and the performance of assets within the entire IT landscape of an enterprise. They learn what the dependencies are inside and outside of IT systems.

Especially in the world of multi-cloud, where enterprises have systems in various clouds and still on-premises, gaining visibility over the full landscape is not easy. How would an engineer tell that the bad performance of a website that hosts its frontend in a specific cloud is caused by a bad query in a database that runs from a data lake in a different cloud?

AIOps requires highly sophisticated systems, comprising the following components:

* **Data analytics**: The system gathers data from various sources containing log files, system metrics, monitoring data, and also data from systems outside the actual IT environment, such as posts on forums and social media. A sudden high number of incidents logged into the systems of the service desk may also be a source. AIOps systems will aggregate the data, look for trends and patterns, and compare these to known models. This way, AIOps is able to determine issues quickly and accurately.
* **ML**: AIOps uses algorithms. In the beginning, it will have a baseline that represents the normal behavior of systems, applications, and users. Applications and the usage of data and systems might change over time. AIOps will constantly evaluate these new patterns and learn from them, teaching itself what the new normal behavior is and what events will create alerts. From the algorithm, AIOps will prioritize events and alerts and start remediating actions.
* **Automation**: This is the heart of AIOps. If the system detects issues, unexpected changes, or abnormalities in behavior, it will prioritize and start remediation. It can only do that when the system is highly automated. From the analytics output and the algorithm, AIOps systems can determine what the best solution is to solve an issue. If a system runs out of memory because of peak usage, it can automatically increase the size of memory. Some AIOps systems may even be capable of predicting the peak usage and already start increasing the memory before the actual usage occurs, without any human intervention. Be aware that cloud engineers will have to allow this automated scaling in the cloud systems themselves.
* **Visualization**: Although AIOps is fully automated and self-learning, engineers will want to have visibility of the system and its actions. For this, AIOps offers real-time dashboards and extensive ways of creating reports that will help in improving the architecture of systems. That’s the only thing AIOps will not do: it will not change the architecture. Enterprises will still need cloud architects for that. The next section discusses how AIOps can help in improving cloud environments.

AIOps is a good extension of DevOps, where enterprises automate the delivery, deployment, and operations of systems. With AIOps, they can automate operations.

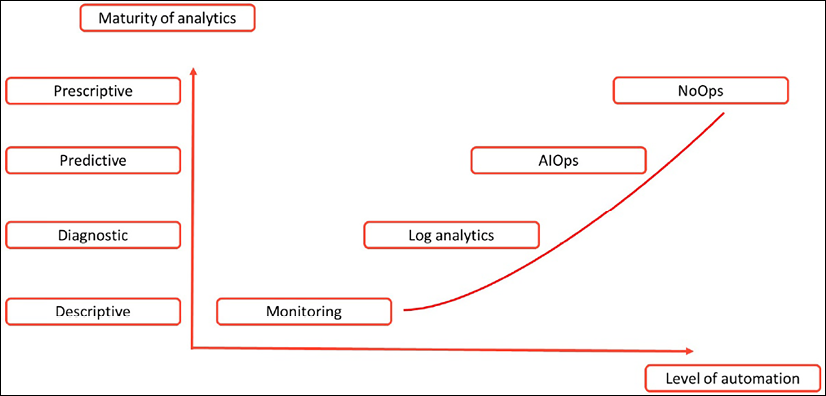
Also, AIOps evolves, for instance, by including security into the concept. A good article about AISecOps can be found at <https://www.forbes.com/sites/forbestechcouncil/2022/02/16/coining-the-term-ai-secops-why-your-business-should-consider-aiops-for-cybersecurity/?sh=57406c1f5449>.

Is there something after AIOps? Yes, it’s called **NoOps**, or **No IT Operations**, where all operational activities are fully automated. The idea here is that teams can completely concentrate on development. All daily management routines on IT systems are taken over by automated systems, such as system updates, bug fixing, scaling, and security operations. But there is a trade-off here: although it’s called NoOps, engineers and some form of governance are still needed to set up the systems and implement the operation’s baseline.

**Optimizing cloud environments using AIOps**

The two major benefits of AIOps are, first, the speed and accuracy in detecting anomalies and responding to them without human intervention. Second, AIOps can be used for capacity optimization. Most cloud providers offer some form of scale-out/-up mechanism driven by metrics, already available natively within the platform. AIOps can optimize this scaling since it knows what thresholds are required to do this, whereas the cloud provider requires engineers to define and hardcode it.

Since the system is learning, it can help in predicting when and what resources are needed. The following diagram shows the evaluation of operations, from descriptive to prescriptive. Most monitoring tools are descriptive, whereas AIOps is predictive:



*Figure 19.1: Evolution of monitoring to AIOps*

Monitoring simply registers what’s happening. With log analytics, companies can set a diagnosis of events and take remediation actions based on the outcomes of these analyses This is all reactive, whereas AIOps is proactive and predictive. By analyzing data, it can predict the impact of changes. The last step is systems that are prescriptive, being able to tell what should happen and already preparing systems for events, fully automated. Some very sophisticated AIOps systems can already do that.

So, we can use AIOps to help us manage and optimize the complex and dynamic nature of these environments. But how do these systems do that? AIOps will use ML algorithms to analyze data from cloud infrastructure, applications, and logs to identify patterns and anomalies that could lead to issues. This enables IT teams to predict and prevent problems before they occur, reducing downtime and improving availability.

Next, with AIOps, we can **automate** the response to common issues in cloud environments, such as scaling resources up or down based on demand, restarting failed services, or reconfiguring network settings. This reduces the need for manual intervention, saving time and reducing the risk of human error.

One of the most common areas where AIOps shows value is **root cause analysis**. When issues occur in cloud environments, AIOps can help identify the root cause by analyzing data from multiple sources and correlating events. This will help to quickly diagnose and resolve problems, reducing downtime and improving service levels. Automation and root cause analysis are ways to continuously optimize our cloud environments. Tools will continuously monitor cloud environments and recommend optimizations based on usage patterns and performance metrics. This includes optimizing resource allocation, identifying opportunities to reduce costs, and recommending improvements to application performance.

Enterprises are discovering AIOps because it helps them in optimizing their IT infrastructure. But how do companies start with AIOps? The following guidelines are recommended to successfully implement an AIOps strategy:

* **AIOps systems are learning systems**: Enterprises will have to learn how to work with and interpret analysis from these systems as well to get the best out of it. So, don’t try to get the entire IT environment under AIOps in one go, but start with a small pilot and iterate from there.
* **Data is essential in AIOps**: This should not only be data that comes from IT systems but also business data. After all, the great benefit of AIOps is that it can take actions that are based on business data. If AIOps knows that certain products sell better at specific times of the year—which is business-driven data—it can take actions to optimize IT systems for that peak period. Also, if it turns out that systems are not used as expected, AIOps will be able to analyze the usage and correlate it with other events. In that way, AIOps can be a fantastic source for the business in becoming a truly data-driven organization. Businesses, therefore, absolutely need to be involved in the implementation of AIOps.
* **Most important in a successful implementation is to standardize**: Throughout this book, it has been stressed that multi-cloud environments need to be implemented in a consistent way, meaning that infrastructure must be defined and configured as code so that it can be deployed in a consistent manner to various cloud platforms. The code must be centrally managed from one repository, as much as possible. This will ensure that AIOps systems will learn quickly how systems look and how they should behave so that anomalies can be detected quickly.

AIOps can also help in testing against real-life scenarios and take much more into consideration in terms of testing. As such, AIOps is a great extension to DevOps and CI/CD pipelines executing frequent releases to applications. AIOps will know which systems will be impacted when changes are applied to a certain system, and also vice versa: which systems will respond to changes in terms of performance and stability. These can be systems that are hosted in different clouds or platforms; they can be part of the application chain.

This problem of the coexistence of applications and systems that disproportionately consume resources is referred to as **noisy neighbor**. AIOps will identify the neighbors, warn them of upcoming changes, and even take proactive measures to avoid the applications and systems from running into trouble. This goes beyond the unit and integration tests that are triggered by a CI/CD pipeline.

Today’s multi-cloud environments are complex, with servers and services running in various clouds. Systems are connected over network backbones of different cloud platforms, routing data over the enterprise’s gateways, yet continuously checking whether users and systems are still compliant with applied security frameworks. There’s a good chance something may be missed when distributing applications across these environments.

AIOps can be used to improve the overall architecture. Architects will have much better insight into the environment and all the connections between applications and systems; this includes not only servers but also network and security devices. Next, AIOps will help in the distribution of applications across platforms and the scaling of infrastructure without impacting the neighbors, even if the neighbors are sitting on a different platform.

**Exploring AIOps tools for multi-cloud**

AIOps helps enterprises in becoming data-driven organizations. From the first chapter of this book, the message has been that IT—and IT architecture—is driven by business decisions. But business itself is driven by data: how fast does a market develop, where are the customers, what are the demands of these customers, and how can IT prepare for these demands? The agility to adapt to market changes is key in IT, and that’s exactly what cloud environments are for—that is, cloud systems can adapt quickly to changes. It becomes even faster when data drives the changes directly, without human interference. Data drives every decision.

That’s the promise of AIOps. An organization that adopts the principle of becoming a data-driven enterprise must have access to vast amounts of data from a lot of different sources, inside and outside IT. It needs to embrace automation. But above all, it needs to trust and rely on sophisticated technology with data analytics, AI, and ML. That’s a true paradigm shift for a lot of companies. It will only succeed when it’s done in small steps. The good news is that companies already have a lot of business and IT data available, which they can feed into AI and ML algorithms. So, they can get started, but first, they will need to select a platform or a tool.

Market analysts expect that the use of AIOps will grow from being worth around 26 billion USD in 2020 to well over 600 billion USD in 2030. This explains why a lot of leading IT companies are investing heavily in AIOps, including big names such as IBM, VMwire, and ServiceNow. Also, cloud providers themselves invest heavily in AIOps capabilities, for instance, in Azure Monitor, which already provides deep insights into the behavior of resources and applications in Azure.

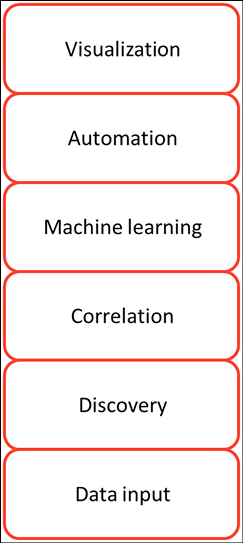
AWS offers CloudWatch and X-Ray. The latter is a distributed tracing service that provides end-to-end visibility into application performance and behavior and allows users to visualize and analyze the flow of requests and responses across distributed systems. X-Ray can identify performance bottlenecks and errors in complex microservices environments.

In GCP, we could identify Cloud Operations—formerly Stackdriver—as an AIOps-enabled tool, since it collects and analyzes metrics, logs, and traces from GCP resources and applications, and provides visibility into operational health and performance. It can also use ML algorithms to detect anomalies and perform root cause analysis.

In OCI, we would look at **Oracle Management Cloud**, a suite of management and monitoring services for OCI. It includes features such as log analytics, application performance monitoring, and infrastructure monitoring, and can be used to automate operational tasks and improve application performance and reliability. It also includes machine learning algorithms to detect anomalies and perform root cause analysis.

How does an enterprise choose the right tool? When an enterprise is working in multi-cloud, it needs an AIOps solution that can handle multi-cloud. These are AIOps platforms that have APIs for the major cloud providers and can integrate with the monitoring solutions of these providers and the third-party tools that enterprises have in the cloud environments. An example of such a platform is Splunk Enterprise, which collects, correlates, and analyzes data from IT infrastructure, applications, and security systems.

In essence, all of these tools work in layers. The layers are depicted in the following diagram:



*Figure 19.2: Layers of AIOps*

Most AIOps systems combine a set of tools in the different layers into an AIOps platform that can handle the various aspects of AIOps.

The market for AIOps is thus rapidly growing. Some examples of more cloud-agnostic AIOps tools are Dynatrace, Splunk, Cisco AppDynamics, Moogsoft, and IBM Cloud Pak for Watson. All these platforms use AI and automation to monitor and analyze cloud environments, including containerized applications and microservices. They provide real-time insights into performance and user experience and can often automatically remediate issues by scaling resources and reconfiguring settings.

These are just a few examples. Keep in mind that each tool has its own unique features and capabilities, and the best tool for a particular organization will depend on its specific needs and requirements.

Key in all these solutions is that they auto-discover any changes in environments in real time and can predict the impact on any other component in the IT environment before events actually occur, as well as from changes that are planned from CI/CD pipelines.

**Introducing GreenOps**

The concept of GreenOps is becoming increasingly relevant in today’s world, where concerns about climate change and sustainability are growing. What do we mean by GreenOps? Before we dive into that, it’s relevant to notice that GreenOps and AIOps are actually quite intensively related. Both concepts make use of AI, as we will learn.

In short, we can define GreenOps as the practice of using cloud technology to optimize the environmental sustainability of IT operations, helping organizations to reduce their carbon footprint and operate in a more environmentally friendly manner. The cloud offers a number of benefits when it comes to achieving sustainability goals. One of the most significant advantages of the cloud is that it allows organizations to use shared resources, which can reduce the overall energy consumption of IT operations. By using virtualized infrastructure and shared resources, organizations can improve the efficiency of their IT operations and reduce the number of physical servers they need to run.

Another advantage of the cloud is that it allows organizations to scale their operations up or down quickly and easily, depending on their needs. This can be especially useful for organizations that experience fluctuations in demand, as they can adjust cloud resources in real time to match the level of demand. By avoiding the need to maintain excess capacity, organizations can reduce their energy consumption and save money on their energy bills.

But how does this compare to AIOps? The answer to that question is that GreenOps also involves automation and machine learning to optimize IT operations and, with that, reduce energy consumption. By automating repetitive tasks and using machine learning algorithms to identify areas for optimization, organizations can improve the efficiency of their cloud environments. For example, machine learning algorithms can be used to optimize data center cooling, which can reduce energy consumption and improve the efficiency of IT operations.

Throughout this book, we have discussed the public clouds: Azure, AWS, GCP, OCI, and sometimes Alibaba Cloud. These are all so-called hyperscalers, meaning that they operate at a large scale, serving thousands of customers around the globe. These customers host their environments in the data centers of these providers. How will customers be able to influence and monitor their energy consumption and environmental footprint? Many cloud providers offer energy monitoring and reporting tools that allow organizations to track their energy usage and identify areas for improvement. They can also use cloud-based analytics tools to optimize their energy consumption and reduce their carbon footprint.

Measures to reduce the use of (heavy) resources, implementing automation and efficient automated scaling, will show directly in this energy monitoring. By optimizing IT operations and reducing energy consumption, we can reduce the carbon footprint, save money on energy bills, and—most important of all—help our world to become more sustainable.

**Summary**

AIOps was a new kid on the block but, since 2020, it has emerged as an almost essential platform for managing complex cloud environments. AIOps systems help organizations in detecting changes and anomalies in their IT environments and already predicting what impact these events might have on other components within their environments. AIOps systems can even predict this from planned changes coming from DevOps systems such as CI/CD pipelines. To be able to do that, AIOps makes use of big data analysis: it has access to a lot of different data sources, inside and outside IT environments. This data is analyzed and fed into algorithms: this is where **AI** comes in, and ML. AIOps systems learn so that they can actually predict future events.

AIOps are complex systems that require vast investments from vendors, and thus from companies that want to start working with AIOps. However, most organizations want to become more and more data-driven, meaning that data is driving all decisions. This makes a company more agile and faster in responding to market changes.

In the last section, we briefly discussed a new concept that becomes increasingly important in using cloud technology: GreenOps. We have to become more aware of the environmental impact of using cloud technology and the data centers of public cloud providers. GreenOps will help us to reduce our carbon footprint and operate our business in the cloud in a more environmentally friendly manner.

After completing this chapter, you should have a good understanding of the benefits as well as the complexity of AIOps. You should also be able to name a few of the market leaders in the field of AIOps. At the end of the day, it’s all about being able to respond quickly to changes, but with minimum risk and, preferably, with a low carbon footprint.

**Questions**

1. AIOps correlates data from a lot of different systems, including IT systems that are not directly in the delivery chain of an application but might be impacted by changes to that chain. What are these systems called in terms of AIOps definitions?
2. Name at least two vendors of cloud-agnostic AIOps systems, recognized as such by market analysts.
3. AIOps works in layers. Rate the following statement as true or false: most AIOps systems have separate solutions for the layers that are combined in an AIOps platform.
4. What is the aim of GreenOps?

**Further reading**

You can refer to a blog and video on AIOps at <https://searchitoperations.techtarget.com/feature/Just-what-can-AI-in-IT-operations-accomplish>.

Helpful blog posts about GreenOps can be found at <https://www.computerweekly.com/opinion/IT-Sustainability-Think-Tank-Embedding-GreenOps-into-enterprises> and <https://blogs.gartner.com/lydia_leong/2023/03/13/greenops-for-sustainability-must-parallel-finops-for-cost/>.