AIOps: The Future of IT

Containerized infrastructure of tomorrow needs AIOps

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The paradigm shift to cloud and as a service models

Today, organizations across industries have tapped into the power of cloud. As companies replace their legacy, on-premise technology with cloud, security and data protection, data modernization, and cost and performance improvement in IT operations have become the key drivers for cloud adoption[1]. In addition, companies are also benefitting from the scalability, application availability and overall ease of management. Gartner has estimated that the worldwide end-user spending on public cloud services will grow by about 23.1% in 2021 to $332.3 billion, up from $270 billion in 2020[2]. Gartner further expects emerging technologies such as containerization, virtualization and edge computing to be at the forefront of this growth.

Depending on the business and IT needs, organizations can select from three different ways in which cloud services can be availed - Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS). The choice between these three models depends on the organization's needs. Each model offers different level of flexibility and control, while eliminating the need for management of on-premise infrastructure.

A multicloud approach/strategy entails more than one cloud service from a single or multiple vendors, with a combination of public or private clouds. The strategy enables enterprises to create the optimal solution from various best-in-class technologies and services. The multicloud approach is gaining popularity among enterprises across the globe and cloud experts. Nearly a quarter (24%) of the

Wipro's State of IT Infrastructure Report 2020 indicates that the single largest spend in IT in the next 3 years will be on data center cloud (IaaS and PaaS), signaling an alignment

respondents in Wipro's State of IT Infrastructure 2020[3] survey did not work with a single cloud vendor, indicating that multicloud adoption has found a firm place in the IT infrastructure strategies of organizations. IDC[4] goes a step further in nominating 2021 as the 'year of the multicloud' with over 90% of organizations expected to leverage on-premises, off-premises, public, and private clouds to optimize their infrastructure requirements.

Different workloads achieve optimal performance and cost utilization on different cloud platforms. For instance, a majority of enterprises might favor AWS for features, scale, and ecosystem, while those that are Microsoft centric might opt for Azure. Google Cloud Platform could be the go-to choice for enterprises when better storage, technology and network are their key requirements. The cloud space is constantly evolving to offer better and smarter options, with increasing demand for `as-a-service' and `pay-as-you-go' consumption models. With businesses aiming to right-size their cloud footprint, they need private cloud for mission-critical applications and public cloud for new projects, development and testing. We are now entering the era of smart cloud.

Is SaaS the way forward?

Among the cloud-based models, Software as a Service (SaaS) is increasingly become a viable option as it is agile, scalable, flexible and affordable. Being a subscription-based model for software, it proves to be an alternative to the traditional IT model where applications are procured, installed, integrated, and productionized for user consumption. SaaS can be availed and consumed on-demand simply by connecting to the service from a public network. Fundamentally, SaaS empowers a business to address its IT needs by offering a variety of choices and reducing the dependence on an IT team to manage, maintain and upgrade applications. Businesses that opt for SaaS find that they can operate with a lean IT department. The popularity of the SaaS model is underpinned by its ability to provide value that goes beyond reducing IT overheads and enabling streamlined distributions and deployment. Figure 1 captures a quick overview of the pros and cons of SaaS.

Gartner expects SaaS to be the largest market segment in the public cloud market, reaching $117.7 billion in 2021 and $138.2 billion in 2022.

The pros and cons of SaaS

Advantages

- Faster time-to-market
- No upfront CapEx
- No hardware issues
- No operations and maintenance
- Scalability
- Better DR and business continuity
- Automatic upgrades

Disadvantages

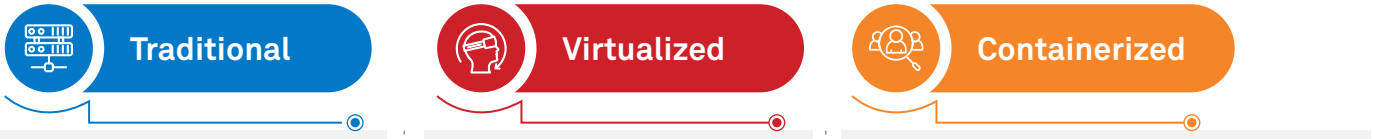
- Vendor lock-in
- Limited integration
- Lack of complete interoperability
- Limitations in customization
- Lack of control
- Compliance issues
- Performance issues

Figure 1: Pros and cons of SaaS

Enabling applications in the future with containerization

The end use of an IT landscape has always been application-driven. The application landscape has evolved with new architecture and the emergence of technologies. This evolution journey is dynamic and will continue to be volatile in the years to come. With the growing need for agility and flexibility, containerization has gained traction over the past few years. Wipro's State of IT Infrastructure Report 2020[5] revealed that about 23% of organizations had adopted container orchestration platforms like Kubernetes and Pivotal Cloud Foundry (PCF), while 37% of respondents claimed that it was in the pilot phase in their organizations.

Application containerization[6] is defined as 'an operating system level virtualization method used to deploy and run distributed applications without launching an entire virtual machine (VM) for each app'. Containerization has allowed developers to produce portable artifacts of code. The term container has been derived from the very early concept of carrying essentials from source to destination in the shipping industry, passing through several check points. The container technology in the context of IT has been around for nearly four decades, with the concept used in Unix systems to isolate application code. Figure 2 outlines the journey of application containerization.



In the initial days when everything was on physical servers, the resources were either over utilized for one application at one point at the cost of the performance of other applications running on the same resources, or if for the application's individual performance dedicated resources were given then those were always under utilized. This was a big gap in the overall capacity management and hence the cost and time management of the operations were limited.

VIrtualization enabled creation of multiple VMs on one physical server and allowed to isolate applications, provision certain level of security within to secure inter applications data within VMs in the same physical server. The issue of over or under utilization of resources was addressed to a large extent. It also made applications deployment less time consuming and cost effective with better capacity management.

DevOps can be considered as the initiation of container based deployments, when VMs and their components were built in the operations factory. This paved the way for fast tracked applications deployments and optimizations for landscape scalability. The VMs today are flexible to share the OS within applications, yet allow the seamless decoupling of applications from infrastructure. With containers, DevOps will be still be the base concept; however the separation of Dev from Ops is required ensure agility in applications build & can be realized by measuring time to release the application rather than the time for environment deployment.

Figure 2: The journey of application containerization

In many cases today, containers are deployed on VMs. This makes the VM the unit of provisioning, and the container the unit of consumption. If the responsibility for managing the VM is delegated to the cloud provider, it becomes a serverless environment. For instance, on AWS , you can turn to Fargate directly for a container from the repository running this microservice in the cloud instead of first provisioning a pool of Amazon EC2 server instances. In so doing, the cloud providers are responsible for handling your technology concerns, freeing you up to focus on your core business asset: your data.

To complete this value chain, there needs to be some adjustment to how you architect your apps; you must capture the operational logs to preserve visibility and measurability in the cloud. You could do it within the organization, but exporting the logs to a cloud monitoring and management service like Amazon CloudWatch would also be beneficial. Other service capabilities in the cloud are equally important, and if you are running a lot of microservices in containers, how can you orchestrate them? You can use cloud services like simple notification service or simple queuing service to auto-scale your resource pool on-demand in an efficient manner. As a result, the unit of deployment would be containers rather than EC2 instances.

A study released by Research and Markets has predicted that the application container market is expected to register a CAGR of 29% over a five year period from 2021 to 2026.

Containerize with Kubernetes or Docker?

At the outset, let's make it clear that Kubernetes and Docker are not interchangeable. Both can run individually and successfully, and can also complement each other.

Docker is an open platform that allows you to develop and run applications, independent of the infrastructure. It basically helps you package and run the application in a container. Docker makes the hosted application look like an operating system (OS) with all its components while other containers might as well be running it on a single system, while Docker is limited to host only one node. Kubernetes gives the flexibility to consolidate multiple nodes of all the running containers and automate the provisioning of the containers. Kubernetes can also automate the networking, load-balancing, security, and scaling across all these nodes from a single command line or dashboard. The multiple nodes are required to:

Make the infrastructure more robust and ensure high availability, given that the application has to remain online

Enhance the scalability of the application – With increased workloads, more containers and/or more nodes can be added to the Kubernetes cluster

Kubernetes is a container orchestration platform that automates the process of scaling, managing, updating and removing containers. Docker is at the heart of the containerization. In principle, Kubernetes can work with any containerization technology. Two of the most popular options that Kubernetes can integrate with are RKT and Docker. However, given that Docker has the most mindshare, the integration between Docker and Kubernetes has been much solid than any other containerization technology. Similarly, Docker Inc., the company behind Docker, offers its own container orchestration engine, Docker Swarm. Even Kubernetes has risen to the point where Docker for Desktop (MacOS and Windows) comes with its own Kubernetes distribution. Both projects have benefited from this synchronicity.

Why should you containerize your applications?

What makes containers better than VMs alone? Container tools such as Docker and Kubernetes make fast, secure deployment of code easier. Because containers run identically on every supported platform, they're also a good way to ready your organization for tomorrow's edge-computing revolution. You can easily run them either on-premises, in the cloud, or locally (in-device) as needed. Whether you run 5, 50, or 500 copies of a particular container in a swarm or cluster (terms used to describe a set of identical containers running as a group), they will be identical, regardless of what it's running on. Docker and Kubernetes will keep containers in step with each other throughout their lifecycle, freeing up the IT operators time.

What's more, switching from VMs to containers saves money. Even a slow partial deployment of containers within your organization will start to yield real savings as containers start to take on more and

more work. Ancillary benefits such as the extra time and power used to spin up a larger, old-style VM versus using new-style containers will have an impact on the bottom line.

Because Docker and Kubernetes are open-source, and because of savings derived from the consolidation of physical servers and virtual machines, deploying containers generally pays for itself, dollar for dollar. The sooner you deploy, the sooner these savings will realize themselves.

What will AIOps mean for containerized resources, cloud and SaaS?

Artificial Intelligence for IT Operations (AIOps) combines artificial intelligence and machine learning (ML) with data science to help address IT task issues and increase capability. AIOps consolidates information and the ML utility to upgrade all essential IT operation functions, including identifying, investigating, and settling accessibility and performance issues.

SaaS is a significant driver for cloud adoption and development. SaaS gives organizations the ability to utilize a wide scope of efficiency upgrading applications on their terms. What's more, innovative software developers are working diligently thinking of new ways for associations to move toward work. Technologies and services must cooperate to be accessible and dependable, and they should be consumable in several ways that organizations that rely on the cloud can accomplish their unique business missions regardless of their underlying cloud technique. AWS and its locale are addressing this need of offering the IT landscape as SaaS.

AIOps makes it possible to view the whole range of the IT environment, whether it's in the public cloud, the customer's cloud or in a hybrid environment that may incorporate public and private clouds, just as on-premises technologies. AIOps as a Service connects the visibility gaps, guaranteeing the most elevated level of reliability, accessibility, and operational intelligence.

Artificial intelligence workloads are consuming an even greater share of information technology infrastructure resources. AI is also taking up residence as an embedded component for managing, monitoring, scaling, securing and controlling IT infrastructure. Increasingly, this emerging IT management paradigm is being named "AIOps." This buzzword refers to two aspects of AI's relationship with cloud infrastructures and operations. On the one hand, it refers to AI as a growing workload that infrastructure and operations are being optimized to support. On the other, it refers to AI's use as a tool to make infrastructure and operations more self-healing, self-managing, self-securing, self-repairing and self-optimizing. In this regard, the growing role of AI in IT infrastructure management stems from its ability to automate and accelerate many tasks and make them more scalable predictably, rapidly and efficiently than manual methods alone. Without AI's ability to perform continuous log analysis, anomaly detection, predictive maintenance, root cause diagnostics, closed-loop issue remediation and other critical functions, managing complex multiclouds may become infeasible or cost-prohibitive for many organizations.

Acknowledging these challenges as well as the potential productivity benefits from embedding AI in infrastructure, more enterprise IT professionals are exploring the growing range of AIOps platforms and tooling on the market. Many vendors have introduced sophisticated offerings that embed machine learning and other AI tools for intelligent, adaptive, 24×7 operations.

Impact of AIOps – Markets and technology

A recent survey from the AIOps Exchange[7] illustrated both the scale of the problems AIOps was meant to solve and the level of interest in solving them, with 91% of those in the survey looking at machine learning-powered tools to make ops teams more productive. Forrester, referring to this as 'Intelligent Application and Service Monitoring', has more conservative estimates, with 51% already using and another 21% planning to adopt them within a year.

The report further states that around 40% of IT organizations in the report over a million event alerts a day, with 11% receiving over 10 million alerts a day. The fact that a quarter of the organizations have 50 or more monitoring tools in their enterprise may account for the sheer volume, but so do the number of different services and platforms in use, with many enterprises handling both legacy applications and new micro services.

AIOps tools promise to reduce the noise by correlating those alerts together into related incidents, by collecting time-series data, building machine learning models to aggregate them and — in some cases — automating collection of further related telemetry. Topology mapping discovers the relationships between devices, or between applications and resources, and statistical analysis ranges from simpler outlier and anomaly detection to more powerful multivariate analysis and dynamic baselining. Dashboards and incident visualizations show performance metrics and event timelines together.

They may also be able to detect probable root causes, find the right people to work on a problem, suggest remediation or automate fixes and predict future problems.

By their nature, AIOps tools need to collect data from and automate remediation actions through existing IT operations tools - database logs, infrastructure monitoring (networking, storage and compute), APM and the application layer, cloud monitoring, cloud services, orchestrators like Kubernetes (and the micro services running in the containers), or configuration management systems.

AIOps with holistic service management on containerization

Today, a large number of enterprise workloads are cloud-based. This vital shift clearly puts the onus on the existing IT operations to handle the probable overwhelming move to micro services. The simple answer - AIOps enabled with ML drives the setup towards cognitive and intelligent automation for the lifecycle of predict and heal. Basically, not only automating the processes but working towards eliminating them.

Whether we currently use cloud-based or on-premises solutions, the ability to seamlessly deploy to the cloud (or even to other locations) is going to be an essential part of keeping up with deployment of AI and other emerging technologies in the future. Persistent storage options are just starting to become available in the Kubernetes infrastructure, making the deployment of applications an option for enterprises hoping to deploy containers. If the organization is currently making the transition to the cloud, this is a great time to also switch to a more container-based architecture. However, without up-to-date IT operations systems capable of overseeing huge data streams, it will be impossible to maintain the steady uptime and efficiency that enterprise systems require. Even then, our legacy monitoring tools may lack the capability to penetrate and make sense of the data arising within and between containers.

This is where AIOps comes into play. The ability to see the contents of containers and track the data being generated by individual microservices as well as microservice clusters is critical, and AIOps machine learning capabilities will form a vital component of the containerized infrastructures of tomorrow.

Indeed, AIOps can already be used in concert with Kubernetes to correlate container-swarm orchestration data with system alerts and logs, enabling IT operators to identify root causes of problems within a single application with pinpoint accuracy—even when its various components are containerized and the containers are hosted, for example, in separate public clouds.

Evolution of IT operations with AIOps

Using traditional incident management systems to deal with increasingly high data volumes, along with container-based systems, will make it increasingly difficult to manage alerts and anticipate future problems. To take full advantage of the benefits containers can bring us, it's essential to have a practical way to monitor everything and resolve issues quickly without wasting thousands of personnel hours manually hunting for the sources of errors.

By switching to an AIOps platform while working towards container adoption, the data flow can be streamlined and organized, while allowing for significant flexibility in deploying current services, maintaining them, and developing new ones.

Traditional incident management systems may have worked well in the past, but they are now unable handle increasingly high data volumes in a world moving towards container-based architecture. Not only will it be difficult to manage alerts today, but anticipating future problems will also be challenging.

Monitoring everything and resolving issues quickly can only be accomplished when personnel aren't wasting thousands of hours manually seeking the hidden sources of errors.

Pairing AIOps platform and container adoption streamlines and organizes data flow while granting flexibility in unique decisions such as deploying your current

services, maintaining the flow or developing an entirely new one.

Adoption of AIOps has been relatively slow. Our State of IT Infrastructure Report 2020[8] indicates that 47% of businesses have no AIOps implementation. These businesses have yet to accept the idea that AI-enabled automation would be the basis of all operations in future. Many organizations are not ready to embrace the changes needed in IT operations with the deployment of automation. However, in the last couple of years, the interest and adoption of AIOps has seen some uptick. Gartner expects the AIOps market[9] to grow at a CAGR of 15% till 2025.

Can AIOps optimize multicloud?

For all the advantages multicloud brings to business, managing and monitoring applications isn't always easy. The mix of on premise, private cloud and public cloud operations with the rapid growth of data, more complex applications and the introduction of new IT architectures can make for a challenging IT environment. As IT operations become critical to both line of business and the customer experience, it is crucial to optimize performance and minimize downtime, while managing the complexity.

The answer lies in automation, and in the coupling of artificial intelligence to operations data in AIOps platforms. AIOps applies machine learning and data analytics to IT operations, in platforms that can ingest operations data from both historical and real-time sources, then analyze it in ways that produce useful, actionable insights. Correlations and patterns become usage trends, signs of performance bottlenecks and warnings of potential failure.

"IT operations are challenged by the rapid growth in data volumes generated by IT infrastructure and applications that must be captured, analyzed and acted on. Coupled with the reality that IT operations teams often work in disconnected silos, this makes it challenging to ensure that the most urgent incident at any given time is being addressed."

Padraig Byrne,
Senior Director & Analyst, Gartner

Possibilities of AIOps – Monitor, manage, automate, control

The key benefits of AIOps are two-fold. Firstly, AIOps provides visibility and clarity for the most complex multicloud environments, bringing together data from disparate sources so that IT teams can see and understand what has happened and more importantly, what is happening. When an application is failing or running slowly, they can isolate the probable cause, while linking patterns or anomalies to events.

Secondly, AIOps provides control. By applying machine learning to historical data and then real-time data streams, it can use the insights generated to forecast issues before they can affect the customer or impact the business. With automation, it can even initiate a fix. The strategic end-goal is systems with their own feedback loops that can monitor the volume, velocity and variety of data and

continuously optimize applications and infrastructure and even, where possible, self-heal. This augments and partially replaces functions normally provided by the IT team, and in turn, gives them space and the visibility they need to make further optimizations and long-term strategic choices.

Making AIOps work requires a shift in thinking and the acquisition of new skills. But as businesses extend their use of multicloud and handle ever growing quantities of data, it's only natural that their operations will grow more complex. AIOps has the potential to meet that complexity and help IT teams regain both visibility and control in the multicloud world.

Gartner's Research Director, Viv Bhalla recommends a phased approach where organizations identify the strategic use cases that could show the most benefits first, and then find the tools and vendors best-equipped to handle them

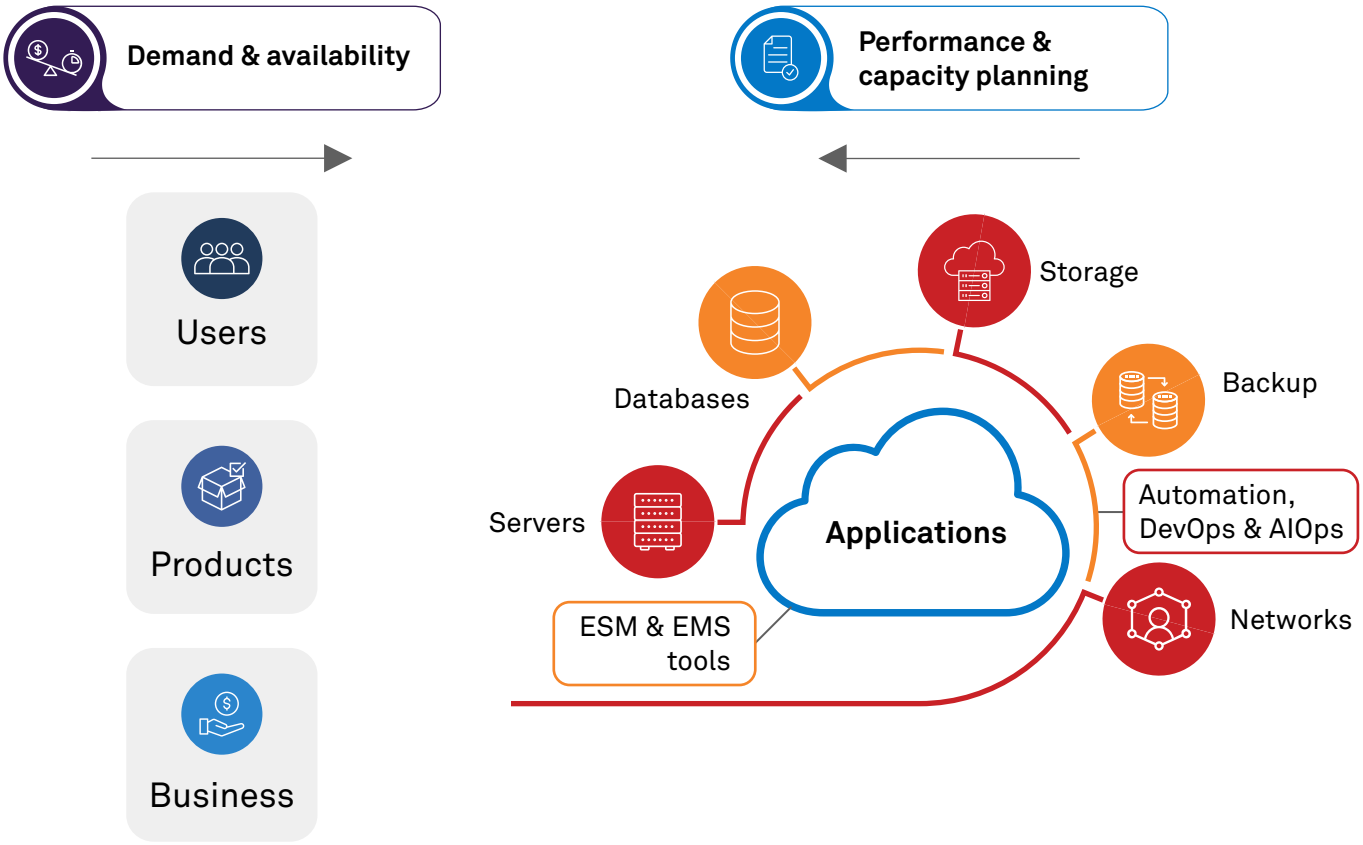


Figure 3: Performance analysis & capacity planning

Making AIOps capabilities an essential component of tomorrow's containerized infrastructure

As organizations turn to digital business transformation, analyzing and deriving business outcomes from the vast amount of data becomes critical. With increasing competition, growing market demands, the need for business agility and responsiveness cannot be undermined. The ability of the IT infrastructure to respond to these demands will determine the pace of the digital transformation. AIOps enable IT operations and service assurance for modern IT, and future thinking companies improve customer experience as they digitally transform.

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Amit works with multiple AIOps and automation technology partners in advancing and modernizing the ESM and EMS tooling space and aligning the overall offering with the ongoing multicloud and microservices evolution journey. He is an enthusiast for humanizing technology to contextualizing with persona-based business asks that focus on end customer usability and ground level business impact.

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