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# Cloud Orchestration in SMEs using K8s and GCP

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***Abstract***

Cloud computing provides users near instant access to seemingly unlimited resources, and provides DevOps Engineers the opportunity to build remarkable cloud - infrastructures. One among them is the cloud native microservices approach to replace the monolithic implementation of both application and its underlying infrastructure. In the era where micro-architecture is ruling the industry it is most necessary that a scalable, robust, fault-tolerant infrastructure should cater the needs of the micro-service application using Cloud Orchestration. Now that containerization is becoming widely adopted, one of the challenges encountered involves the ability to orchestrate a set of highly complex subsystems (compute, storage, network resources) that span large geographic areas. One amongst the dominant cloud native services that can provide the infrastructure to back the needs and also capable of handling demanding workloads is Kubernetes, a container orchestration platform with self-healing capabilities. Kubernetes can be used for deployment on infrastructure, platform, application, micro-service levels and deployments across many distinct cloud resource providers. Deploying and scaling containerized applications using Kubernetes is gaining traction in Continuous Integration / Continuous Deployment (CI/CD) software engineering. The Proposed system of cloud orchestration is a solution that enhance cloud functions and features by setting tools to manage interconnections and interactions. Cloud orchestration will also enhance automation of service deployment. Cloud orchestration arranges and coordinates automated tasks that result in the systematic workflow for Small and Medium-sized Enterprises(SMEs).

***Keywords—*** Orchestration, Containerization, Kubernetes, Google Cloud Platform(GCP), Cloud

## 1.Introduction

Cloud coordination is the utilization of the incredible programming innovations to deal with the interconnections and collaborations among open and private cloud foundation. To computerize errands into a methodical work process to accomplish an objective, with substantial benefits and strategy.

IT association that wished to build up the IT framework to have an application would confront huge hindrances. They would make the underlying business case and hang tight for endorsement from the board before the equipment could be bought. At that point, IT administrators would introduce a working framework, associate with and design organizing, set up an IP address, allot some extra room for the application, arrange security settings, convey a database, and interface the server with back-end frameworks - all before sending the application. One of the advantages to embrace cloud is the chance to lessen expenses, and one of the most encouraging certainty is the robotization and arrangement of cloud framework. Via robotizing arrangement, and the board of cloud-

based foundation, association can save time and assets for other imaginative errands rather than day by day support. A portion of the cloud Orchestration sellers are Amazon Web Services(AWS) CloudFormation, Google Cloud Platform(GCP), Microsoft Azure Automation. 2019 State of the Cloud Report makes it

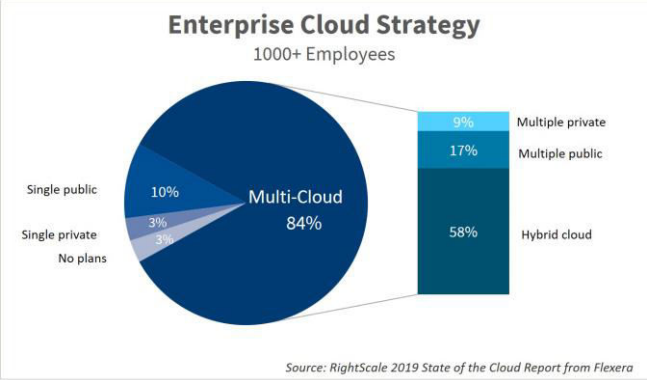


Fig 1 : Enterprise Cloud Adoption (%)[Source : RightScale]

Small and Medium-sized Enterprises(SMEs) uses a combination of public cloud, and private cloud to deploy application in a different form of cloud named as hybrid cloud, and generally, when cloud provider uses two or more cloud which is known as multi-cloud.Thereare so many types of cloud computing is usedin an organization, that's quit bit complex. In the last two decades Cloud infrastructure deployments became large and more

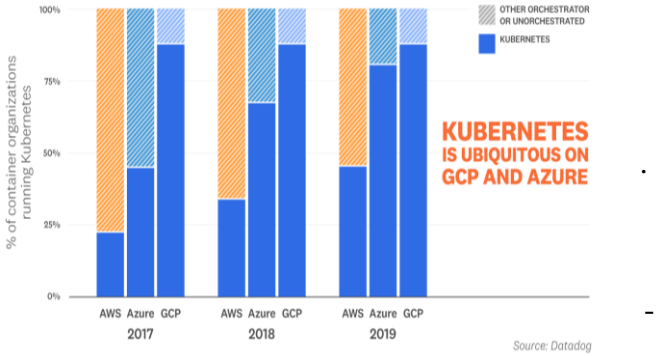


Fig 2 : Kubernetes Usage by Container Organization [Source: Datadog]

At present Orchestration is considered as a standard practice for any undertaking utilizing

understood: As open cloud reception and endeavor cloud spend develop, the utilization of various mists is a purposeful methodology for an expanding number of enormous associations. Completely 84% of undertakings are now multi-cloud as indicated by the current year's report, and that number is up 3% from a year ago

elaborate since the enhancement of cloud-computing paradigm. The growth in the number of components for intercommunication and multiple application programming interfaces (APIs), and additional features to enable flexible scalability and computation efficiency will increasethe complexity. As a result, Demand of cloud orchestration became more in all stages of the cloud infrastructure lifecycle.

Kubernetes is a leading cluster service provider which is use to scale container technology, which basically used for deploying micro-services to gain maximum benefits. Using containers technology such as Docker and cluster service such as Kubernetes will help when any single part (micro-service) fails than it will not put the whole applications down. The whole management of containers and their scaling features are monitored and administrated by Kubernetes cluster services. Kubernetes is leading cluster services since 2017.

compartments. Presently it's undeniable in the ascent of Kubernetes utilizations, which shows only an appeal of cloud arrangement with a compartment based sending. As of October 2019, generally close around 45% of Datadog clients running holders use Kubernetes, regardless of whether in self-guided bunches or through a cloud administration like Google Kubernetes Engine (GKE), Azure Kubernetes Service (AKS), or Amazon Elastic Kubernetes Service (EKS). That speaks to a 10-point gain in Kubernetes selection over the past a year, and a 20-point increase over the past two years.

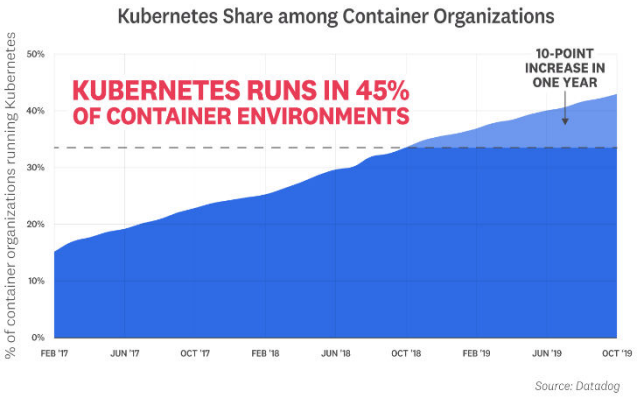


Fig 3 : Kubernetes Share among Container Organization [Source:Datadog]

## 2. Literature Survey

The paradigm shifted from monolithic architecture and into the world of microservices, and the adoption of microservice based architecture and even server-less technology seems promising with incremental improvement in the way redefining modularity. With all the exemplary advancements, many multinational corporations have begun operating with and even contributing to the microservices project. This particular platform most preferred is Kubernetes. Kubernetes the orchestrator is an open source platform that defines a set of building blocks which provides a mechanism that can deploy, maintain, scale and heal the containerized microservices. Thus, hiding the complexity of the microservice orchestration while also managing their availability.

In this paper [1] , Authors Ilia Baldine, Describes the experience of working for the development of the distributed linked configuration of all the intertwined resources, leverages various architectural solutions. (loosely coupled approach, declarative resource definition, unique deferred instantiation approach). Which addresses a vast set of constrictions pertaining to autonomic scheduling and provisioning of the distributed but networked resources.

The authors [2] Changbin Liu Describes cloud computing as accessibility for anyone to access virtually an unlimited resource pool. Taking advantage of this approach, cloud service providers build and offer complex IT infrastructure as a service to potential customers, by also providing the monetary benefits of the scale, increased affordability through infrastructure sharing.

In this paper Authors Sang-Ho tells about Describes the way cloud computing has revolutionized the IT technologies by separating the application and the information resources from the underlying infrastructure. The Hybrid or the personalized cloud computing model offers the benefits of the cloud while also providing an added layer of security, reducing the overall risk factor[3].

Author Illustrates the survey conducted on MEC (Multiple Edge Computing) and describes the fundamentals of enabling core technologies. It elaborated that the orchestration of edge computing by considering both individual services and also the networking of the platforms which support mobility. Analyzes the different orchestration techniques. In addition to this, the paper also covers various architectures and deployment scenarios. Which discusses multitenancy support for the DevOps engineers, content providers and third party entities. Finally, as a conclusion, it provides an overview of the current normalization of the activities and also the research requirements and challenges [4].

In this paper [5] Authors “Daniel Baur State that even though the cloud regime began about a decade ago, many anomalies are still existent. This may be vendor-lock-in or poor technical documentation and support. Which restricts the way in which the benefits of the cloud could be utilized efficiently. These restrictions have paved way to various third party tools that focus on administrative management and orchestration of the cloud application. However, all these tools promise to deliver similar functionalities and are barely distinguishable amongst one another.

Which then again poses an issue of choice for the developers.

In this Paper Authors [6] Khadija Explains that one of the most challenging scenarios faced in the production environment is to orchestrate a set of complex subsystems that may span large geographic areas serving various purposes. To simplify the process, the authors, propose a Cloud Orchestration Policy Engine (COPE), which is a distributed platform that allows for cloud providers to provide declarative and automated cloud resource orchestration. The policy engine, specifies system wide constraints and goals using logs; A declarative policy language geared towards configuring constrained optimizations. In a way, simply put. The policy is taken as a consideration and the cloud system optimizes all the cloud resources such that operational objectives and SLA's can be met.

In this paper Authors " CHangbin Liu, Boon Thau Loo, Yun Mao" one of the difficulties confronted includes the capacity to arrange a profoundly unpredictable arrangement of subsystems (process, stockpiling, organize assets) that length huge geographic regions serving differing customers. To facilitate this procedure, we present COPE (Cloud Orchestration Policy Engine), a disseminated stage that permits cloud suppliers to perform definitive robotized cloud asset arrangement. In COPE, cloud suppliers indicate framework wide imperatives and objectives utilizing COPElog, a definitive approach language outfitted towards determining appropriated requirement enhancements. Adapt takes strategy details and cloud framework states as information and afterward streamlines process, stockpiling and system asset assignments inside the cloud with the end goal that supplier operational targets and client SLAs can be better met [7].

The Author NicolaePaladi, Cloud arrangement systems are generally used to send and work cloud . Their job traverses both vertically (organization on framework, stage, application and microservice levels) and on a level plane (arrangements from numerous particular cloud asset suppliers). In any case, in spite of the focal job of coordination, the well known organization structures need instruments to give security certifications to cloud administrators. In this work, we examine the security scene of cloud arrangement structures for multi cloud framework[8]

## 3. Proposed System

The SME migration to cloud computation is continuously being hastened by salesperson who are giving support to different intense business needs. These products include both end office software like CRM solutions. Some software development companies that provide SMEs with specific goals that are built from scratch and are being adapted to the individual SME's specific business needs. Cloud Orchestration offers countless benefits for SMEs. Data stored in hardware are mostly in risk of threats like humidity, damage in natural calamities, theft, and hardware redundancy. There is no any effect on cloud backup and resolve several SME concerns like adaptability, economic viability and business dexterity. Once you have managed to compose your business suite in the cloud, an SME can enjoy the advantage of doing seamless business from different locations. This also serves the best of SMEs economic interests as there is no stake in lengthy planned expenses and the pay-as-you-go model proves to be extremely worthwhile in the long run.

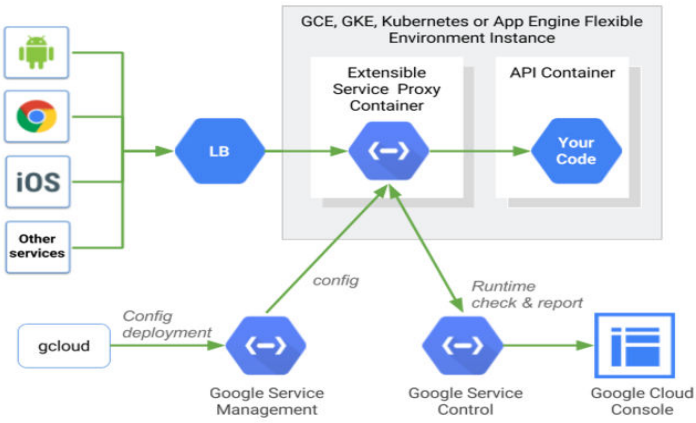

Fig 4: Workflow of Services using GCP and K8s[Source: GCP site]

Distributed API management system with services, runtimes and tools are called Endpoints. Endpoints are used to manage, monitor and authenticate. The components of Endpoints are:

- Extensible Service Proxy (ESP)
- Service Control
- Service Management
- Cloud SDK
- Google Cloud Console

ESP runs in front of the backend and injects Endpoints functionality using NGINX based proxy to provide authentication, monitoring, and logging. ESP uses a service configuration which is available in Service Management and uses it to validate all incoming requests. ESP is designed in such a way that it can be deployed in a containerized environment and validate JWTs and Google ID tokens. It basically uses different techniques such as heavy caching and asynchronous calls to remain lightweight and highly performant.

- Service Control
- Service Control uses API management rules at runtime to provide check and report
- Service Management

gRPC service in a YAML file referred to as the Endpoints configuration. Deploy the Endpoints configuration files to Service Management by using the Cloud SDK, which will configure the API management rules. Other configuration tasks are also done here like sharing API with other developers, enabling or disabling the API in different projects, and generating API keys.

The Cloud SDKprovides gcloud command-line tool that can be use to make calls to various Google Cloud services. The gcloud command-line tool are used to deploy Endpoints configuration to Service Management.

Google Cloud Console is the graphical user interface of Google Cloud. Endpoints uses the Cloud Console to expose data that are sent from ESP and recorded by Service Control and share APIs with other developers.

Deployment scenarios ,ESP is designed to deploy it in a container with each instance of backend. It removes the network hop typically associated with proxies and allows API management that is highly performant as well as scalable. Load balancing is applied before traffic hits ESP for Compute Engine it is taken care by Cloud Load Balancing. For Kubernetes deployments, one can use an ingress proxy for load balancing. Google Kubernetes Engine, uses Cloud Load Balancing or an ingress proxy for load balancing.

First ESP obtains its service configuration from Service Management. The service configuration YAML file is generated from the OpenAPI specification or from gRPC. It tells ESP to manage both the API and policies like which methods require authentication, and which require API keys.The following diagram shows the overall architecture where ESP runs as a side-car container in front of the API service application container, with my-api API hosted at my-api.com and backed by a Kubernetes service

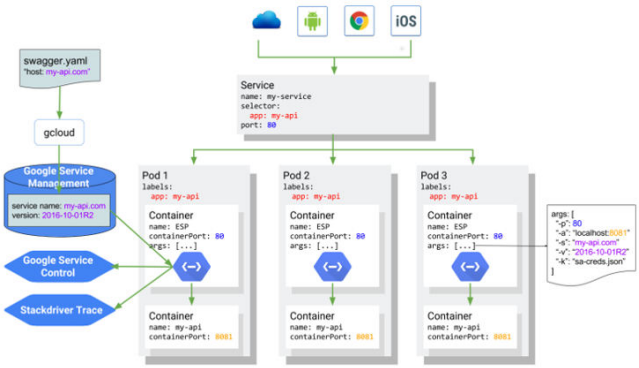


Fig 5: (ESP Config(.yaml) files )

## 5. Conclusion

To conclude the paper, give the objectives and the outcome as conclusion it can be said that the key objectives which was to containerize an application and make use of Kubernetes to

orchestrate the entire infrastructure that was built on a cloud platform was set to be achieved was completed successfully. However, it is believed that this paper barely scratches the surface of Kubernetes and its potential which could be explored further by extensive study and research.

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