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# Hybrid Cloud Deployment: Best Practices for Application Engineers

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**Abstract:** This paper highlights the discussion of hybrid cloud deployment and its best practices for application engineers. Hybrid cloud deployment methods have become the new standard for organizations. Hybrid cloud deployment is important for application engineers since it may be utilized to expand on-premises sources within an organization. These days, the hybrid cloud deployment model, or HCDM model, is thought to be the most effective cloud computing paradigm due to its open-source features. Application engineers can maintain computing power based on consumption and fluctuations thanks to hybrid cloud computing. The author also explains how hybrid clouds offer the best resources, security, and scale and cost advantages. Cloud architectures are being improved as the cloud ecosystem develops and innovates further. Application engineers can use hybrid cloud deployment to evaluate workloads and make the switch to a hybrid cloud based on user needs.

***Keywords*****:** HCDM (Hybrid cloud deployment model), AWS, CI/CD, Devops, Docker-package, SIEM systems (Security Information and event Management), IDS (Intrusion detection system), Firewall**]**

## Introduction

Cloud computing use has grown as businesses transition to digital transformation. The majority of businesses that depend on product agility in addition to data-driven analytics shift their digital activities to the cloud. For businesses looking for a flexible solution along with a safe infrastructure solution, cloud computing offers greater value. Notable, cloud provides a wide range of models, types, and services. It can be divided into three categories: private cloud, public cloud, and hybrid cloud (Goyal, 2014). Among all of these, “hybrid cloud deployment” techniques have emerged as the new norm for businesses. For application engineers Hybrid cloud deployment is a key as in an organization it can be used to increase on-premises sources. It also helps in creating different pathways to Amazon Cloud Service instead of an instant migration. With the help of Hybrid cloud deployment application engineers can access to most updated technologies. Depending on the amount of data they store, hybrid clouds can scale dynamically. For example, when a health-related query has a significant demand, more nodes can be set up in the public cloud to efficiently manage inference in data. For application engineers some best practices of hybrid cloud deployment are to adopt containerized architectures, develop efficient hybrid-cloud strategy, implement more efficient security practices, adopt cloud-native, application of Devops, grasp of HCDM management tools, etc This paper will demonstrate some of the best practices of Hybrid cloud deployment by the application engineer in increasing productivity, increasing the resources and boosting data security.

## Literature Review

### Hybrid cloud deployment: public and private cloud computing

Research carried out by Aryotejo and Kristiyanto 2018, shows that cloud computing nowadays considerably emerges as an efficient and effective paradigm. The application engineers widely apply cloud computing in IT startup organizations. As per the research it is evident that the HCDM model (Hybrid cloud deployment model) has attributes as open-source, nowadays which is considered the most efficient cloud computing model (Aryotejo and Kristiyanto 2018). Research shows that in today's digital age digital data security is considered as one of the major issues for the startup organizations in the IT sector. For example, the majority of Indonesian IT company founders lack technical IT experience and this has become the main reason for failing to manage data security.

Cloud computing is a platform where both the hardware, software with networking systems play a vital role. HCDM, which is a combination of internet with private cloud has the ability to run any applications throughout integrated computers at the same period of time. In addition, the application engineers use the HCDM model to accurately operate IT infrastructure in an organization that significantly decreases the capital expenditures and operational expenditures (Dhar, S., 2012).

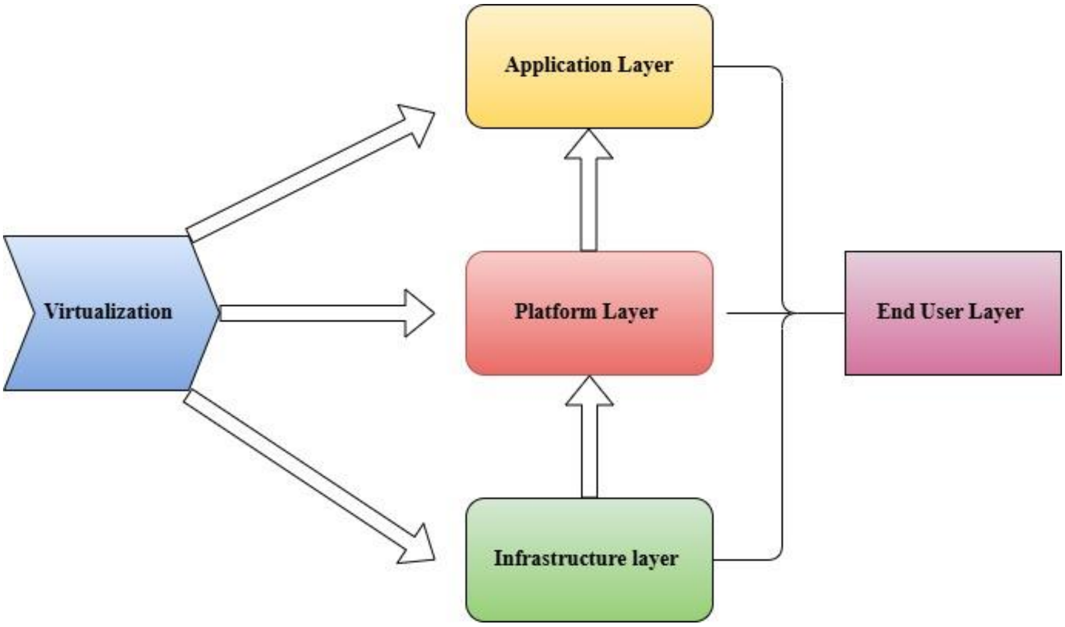

**Figure 1: Cloud computing service distribution**

**(Source:** self-created in draw.io**)**

**Hybrid cloud and its application & architecture**

According to Srinivasan *et al.* 2015, hybrid cloud allows application engineers to maintain the computing power in regard to their usage and fluctuations. The author also states how the Hybrid clouds provide best scale and cost advantages along with best security and resources. As the cloud environment continues to evolve and innovate, efforts are being made to improve some aspects of the cloud architecture. Workloads can be assessed by the application engineers with the help of Hybrid cloud deployment to transition to a hybrid cloud based on user requirements (Srinivasan *et al.* 2015). With the help of Hybrid cloud deployment application engineers can improve and extend existing applications for instance for relocating packaged apps without recoding or restructuring to a hybrid cloud that works with a particular data center. With the help of hybrid cloud deployment application engineers can develop next-gen applications for instance cloud native with mobile apps in regard to cloud development frameworks. For application engineers best practices of hybrid cloud deployment are as follows: adopt containerized architectures, develop efficient hybrid-cloud strategy, implement more efficient security practices, and adopt cloud-native, application of Devops and continuous integration /continuous delivery and grasp of HCDM management tools.

**In hybrid cloud deployment best practices for application engineers**

As per research in Hybrid cloud deployment some of the best practices for application engineers are as follows:

For creating more flexibility the application engineers use containerization technologies such as "docker-package" applications as well as its reliance, securing more stability in surroundings. Implementing microservices architectures is also one of the key aspects as the application engineers break the apps into small scale and use HCDM management tools like Amazon Web Service, Terraform to demonstrate and furnish the security infrastructure consistently. In addition, data classification implementation, data locality development, and making some data-synchronization methods are some of the key practices for an application manager as all these together critically optimize the data management (Rao *et al.* 2015). To ensure the security framework identity management centralization is important. The application manager applies federate identity to balance the compatible authentication as well as authorization.

Streamline activities and track the tasks such as adoption of unified monitoring, creating compatible logging, routine tasks automation, setting operational limitations are also considered as key practices for an application engineer in hybrid cloud deployment (Rao *et al.* 2015). The application manager applied automation for formation stationing, ascending, and recovery operations. Under the aspect operational limitations the application manager determines which teams are in charge of the various hybrid infrastructure components.

### The hybrid role: Application engineers and security practices

Innovations in technology like blockchain, AI, as well as machine learning are having a big impact on cloud security procedures (Gudimetla, and Kotha 2019). For example, blockchain technology has been utilized to improve transparency and verification across dispersed networks, while machine learning algorithms are used to anticipate and eliminate vulnerabilities before they have a chance to do any damage. As per the research by the authors Gudimetla, and Kotha 2019, it can be stated that, into the hybrid cloud development lifecycle security integration basically includes implementing a security framework as per design philosophy. As per authors, this may incorporate threat modeling at the development period, continuous delivery/continuous integration (CI/CD) pipeline, security controls integration, to track the vulnerabilities adopting code analysis tools.

## Methodology

### Development of technical advancements in Cloud computing

The idea of time-sharing, which established the foundation for shared computer resources in the year of the middle 1960s, marked the beginning of the development of cloud computing. In the year 1999 the salesforce launch pointed out the commercial accessibility of internet-based services. As time passed, technologies developed, and with this development some crucial aspects have been created such as automated management, architectures that are service oriented, virtualization etc. These aspects helped in shaping cloud computing. In addition, Docker with containerization and Kubernetes with orchestration simply rationalized both the classification and application management in a cloud environment.

### Cloud computing and current trends

Hybrid cloud deployments in the cloud computing environment are considered as one of the current trends as this provides more efficiency in cloud security. Additionally, edge computing also became famous for its capability in quickly noticing the latency issues caused by the processing data closer. Future developments in cloud computing are anticipated to include deeper integration with IoT devices, widespread use of AI for automated tasks, especially breakthroughs in quantum cloud computing, which would provide previously unheard-of processing power.

### Tools and technologies that make security integration easier

In security integration there are numerous tools and technologies that take a vital role such as the SIEM systems (Security Information and event Management), IDS (Intrusion detection system), and Firewall. All these are important for not only monitoring the resources but also important in protecting the resources. In addition, with the help of configuration management tools such as Amazon Web Service, Terraform the application manager can balance the security baseline.

## Results

### Security measurements

The security threats linked with cloud computing have also increased due to its rapid proliferation. Cloud computing security is complex and includes safeguarding security infrastructures, data, and apps against intrusions, breaches, and other online vulnerabilities (Gudimetla and Kotha 2019). More than that, the security management is made more difficult by the dynamic nature of cloud settings, where resources are frequently shared and allocated dynamically. This dynamic nature frequently leads to security flaws that criminal entities could take advantage of.

**Hybrid cloud deployment model topology**

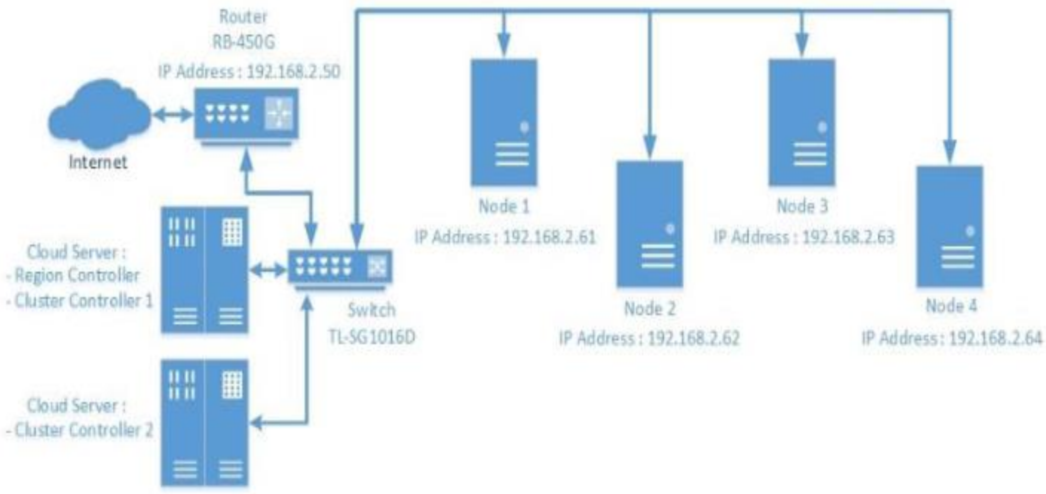

**Figure 2: HCDM design and logical topology**

**(Source:** https://iopscience.iop.org/article/10.1088/1742-6596/1025/1/012091/pdf)

The above topology figure showed the Hybrid cloud deployment model design with logical topology. As per the figure for enabling the communication between the hardware TP-link and Mikrotik has been used (Aryotejo and Kristiyanto 2018). If one checks the topology figure one can notice that Cluster Controller 1 has been used as the primary server of the HCDM model. In this study the software that has been used are basically open source software which are JUJU, uBuntu and MAAS. And as the Hybrid cloud deployment model operating system uBuntu has been used. Because of providing more efficient automation as a physical server the MAAS has been used for data center operations. The hardware components that have been used are as follows, Mikrotik RB-450G as a router, TP-Link TL-SG1016D as switch and Acer VTM480G as a cluster controller.

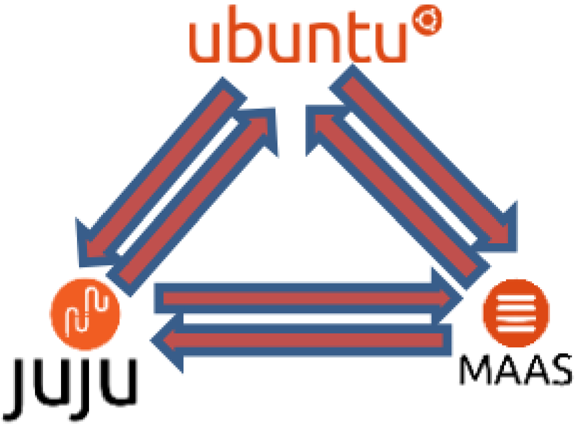

**Figure 3: The implementation of uBuntu, JUJU and MAAS Software**

(**Source:** https://iopscience.iop.org/article/10.1088/1742-6596/1025/1/012091/pdf)

## Discussion

Based on research it can be stated that the in server provisioning system Hybrid cloud deployment model plays a key role that removes all the complexities in local-based cloud computing through online.

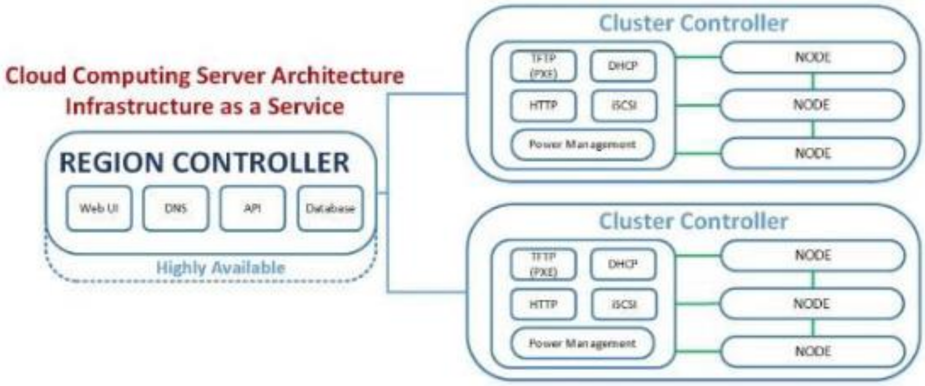

**Figure 4: Private Cloud Model**

(**Source:** https://iopscience.iop.org/article/10.1088/1742-6596/1025/1/012091/pdf)

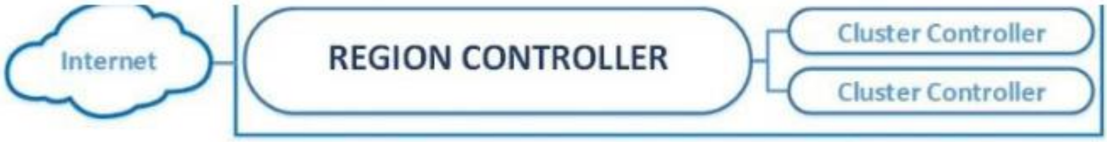

**Figure 5: HCDM**

(**Source:** https://iopscience.iop.org/article/10.1088/1742-6596/1025/1/012091/pdf)

The above figures define that the Hybrid cloud deployment model as cloud-computing behave like a private cloud that includes a cluster controller, two modules and region controller and all are connected to the internet. In the above Hybrid cloud deployment model the region controller is used as checking the user management and the nodes and also interacting, establishing communications between multiple cluster controllers. Additionally, in the model cluster controller is used to balance the power stats, operating systems deployment and manage the images. As per the analysis to estimate the Hybrid cloud deployment model security some initial security measures have been performed where the connection was facilitated by the client to the Hybrid cloud deployment model and public cloud. And the entire process was monitored by connection analysis (Aryotejo and Kristiyanto 2018). As per the above topology model and analysis it can be stated that for application engineers the HCDM model deployment can be beneficial as this helps in workload identification, end-to-end orchestration, security infrastructure and frameworks. While deploying different applications on “hybrid cloud” some key objectives should be highlighted by the application engineers such as comprehensive monitoring, seamless data integration, consistent evaluation, robust security and based on the continuous environment workload optimization.

**Future Directions**

As cloud adoption expands and cyber threats become more sophisticated, cloud security is expected to encounter greater difficulties and online vulnerabilities in the future. More effective AI-driven security technologies will be integrated, and safe cloud architectures such as Zero Trust will be more widely used, according to future optimistic researchers by Rochwerger *et al.* 2009 and Santos et al. 2009. For hybrid cloud application deployment some of the main practices for application engineers are consistent management, scalability, data integration, cloud networking both private and public, Devops practices. These studies highlight the continuous need for creative and flexible security solutions by indicating that as cloud computing develops, so too will the tactics and tools required to safeguard it.

## Conclusion

Application engineers should implement some strategic approaches that precisely manages the operational efficiency, overall flexibility and cloud security framework at the time of deploying hybrid cloud. In addition, by adopting security infrastructure, containerization tools application engineers can secure the application flexibility in the cloud environment. From the above research it can also be stated that well planned data management approaches, automated continuous integration/continuous delivery (CI/CD) pipelines, and unified tracking solutions effectively decrease and maintain the complexity and also streamline the entire operation procedure. On the other hand, intelligent workload distribution combined with the cost optimization increases the financial benefits of hybrid cloud deployments. Application engineers that follow these principles are going to create solutions that effectively capitalize on the advantages of both private and public cloud platforms while minimizing their respective drawbacks as hybrid cloud environments keep developing.

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