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A Literature Survey on Transformation of Cloud Journey



Abstract: - Ages of decade Cloud Journey play a pivot role in the modern business. Cloud Transformation Journey is a Collection of Software Management, Hardware Management, Accessing of Data, Networking, Security, Malware, End user compute services, back up services and Storage services that do not require any knowledge for the end users to be aware for the servers that are hosted, how they are managed and configured in the space of Cloud. Cloud transformation journey is the new way of modern technology art of delivering the services to the end consumers so called the clients for the business to be kept up and running. There are various delivering models that could be adopted by the business clients based on their own demands. This survey tries to help and understand the various options of business clients to select their priority models bases on their business needs. Cloud Transformation is moving towards the next phase in various spaces of SaaS, PaaS, IaaS, BaaS and Storage as Service. In this paper it is to describe the various concepts of Cloud Transformation.

Keywords: Cloud Computing, SaaS, PaaS, IaaS, back up as service.

I. INTRODUCTION

In the recent years, Cloud Computing [1] has become a Transformation journey that gain wide influence on IT Systems. Over several years in the past, there has been a significant interest in the acceptance of Cloud computing by major IT organizations and enterprises. Cloud computing is often described as a stack, as a response to the board range of servers built on top of one another under the cloud. Cloud computing is a model of enabling convenient, on-demand services to be shared pool on configurable computing resources as network servers, backup, storage, applications and services. It is easy and convenient to provision of any servers with a standard configured capabilities that is built over the base template with minimal effort or services provided interaction. Although the terms Cloud sometimes refers to collection, practice, research old or new concept in various research field like Service oriented architecture, distributed, grid-computing, edge computing [2]. Such resources include Infrastructure as a Service (IaaS) [3], Platform as a Service (PaaS), Software as a Service (SaaS) [4], Backup as a Service (BaaS) [5]. Clients do not own any of the resources, but applications and the data are guaranteed to be made available and an uninterrupted or minimal interrupted services would be available of the hosted services via the web services and their associated web API's that caters to the layers that the API perform in the cloud. Cloud Transformation mainly allow the enterprise organization to focus on their business opportunities, their end user need, stability and security of their business needs for their increased revenue and productivity. In the Cloud computing environment users have the liberty to access their hosted applications, data be it on the physical device as file system or on the shared storage through the Storage Area Network (SAN) attached to the virtual servers or machines based on their storage need and the services that they have opted for consuming their business need regardless of their location accessed through the browsers, Remote Desktop Protocol (RDP) if they are in the secured network zone. The application could be connected via the secured network connection through Virtual Private Network (VPN) or through the intranet to ensure that the applications and the associated API's [6], database, data are assessed in a secured approach not exposing to the external vulnerabilities. There are various types of Cloud computing that are available for the enterprise to opt and use which is called as "Pay as you use" [7]. Cloud computing caters to various architectural approach based on the business need. There are various types of business globally pertain "Utilities", "Banking", "Retail", "E-commerce" where certain enterprise business need "Public", "Private" or "Hybrid" Cloud models [8]. In addition to the Cloud model the enterprise organization can opt their services in the areas of "SaaS", "PaaS", "IaaS", "BaaS" based on their business need. Cloud computing are expanding drastically in the enterprise organizations as they are looking for cost benefit, effectiveness, better services as service level agreements (SLA) [9], service level objectives (SLO), KPI's that are agreed as target for metrics that would be measured against the hosting services. Cloud computing focus on more reliability, scalability and elasticity as we grow in the business. Recent research focus more on trustworthy partners those who could provide better services with less downtime of the hosted services. When found on better services the business should be made knowledgeable in the Resiliency, Disaster Recovery (DR) patterns based on the cloud architectural design that

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is made for the hosted services. Enabling the feature of auto-scaling, elasticity [10], load balancing would be easy for the business to be smooth in their operations with High Availability (HA) and extending their SLAs to thresholds agreed. Based on the service models selected by the business, Cloud computing capability of service changes based on the technical assessment. However, Cloud computing is changing the new modern IT technology where the enterprise organizations would like to be in the future.

This work would concentrate on all the aspects of Cloud computing expanding the ideology of SaaS, PaaS, IaaS as there are many concerns that need to be explored in the area of IaaS. The rest of the paper is organized as II. Background Study which gives bigger view on what is happening on the recent times against Cloud transformation, their associated service models, cloud model, III. Literature review section present the analysis outcome of the study that had been undergone and identification of gaps that will be the part of further narrow down to current research methodology, IV. Results and discussion and V. Conclusion

II. BACKGROUND STUDY

Cloud computing is mostly categorized as Cloud models and the services offered by different service providers. It commonly falls under Software as a Service, Platform as a Service, Infrastructure as a Service [11] and recently Backup as a Service. There have been many years now that the cloud computing is been discussed globally that cater to the business need. In the current trend most of the business has still been delivered out of on-premises (Traditional) datacenter [7]. As the current deliverable model has drawbacks that lead to significant delay on rectifying the issues that could go down for the business continuity. A comparison study of on-premises [7] and Cloud computing has been discussed for the new cloud computing approach refer Table 2

Datacenters those that are still operated by many service providers have different hardware and software resources for running the applications that gets deployed in the servers [13]. If the end user needs low-cost operating model, then they need to compromise on the Quality of Service (QoS) [13] and the cost of service is based on the number of server quantities that are hosted in the traditional data centers. Enterprise organization need to assess their software license management that are consumed for the business to be supported. It does not stop only on the number of devices that are in the data center consumed by the enterprise organization but also the number of CPU's, memory and storage allocation provided by the service provider to the enterprise for their business to be running.

Considering the issues that are currently faced in the traditional data center model, it had become evident to focus on the Cloud computing. Cloud computing helps the IT department of the enterprise organization to spend majority of their focus on improving their business needs and less on their technology maintenance. Stating from the financial need the maximum cost that is spent is on investing in the hardware procurement which could be higher on their capex. There are MRC – Monthly recurring charges that need to be factored for managing the servers that are hosted. In addition, there are depreciation cost that could be for a minimum tenure month from the day of any hardware commissioned along with power, floor space, storage.

As described above on the drawbacks that had to be overcome is via building or adopting Cloud computing as solution. Journey to Cloud or migrating from on premises to Cloud [15], it is needed to go through the Cloud Architectural design. Cloud architecture need to be robust, flexible, scalable that involve multiple cloud components [22] that need to be communicated between each layer. Cloud service model that are described as in Fig.1 on service model architecture.

Service models

Cloud computing can be divided into two sections: Overlay and Underlay. The consumers are those who uses the overlay, whereas the underlay has been managed by the service provider that shows the management, scalability, security of the cloud platform, where the end user has no visibility as mentioned in Fig.2 service model ownership.

SaaS

In this service the cloud provider leases the software, or the required applications selected by the customer for their business use. For understanding, SAP or CRM module that is provided by any cloud provider on the cloud infrastructure have been owned and managed by the service provider and not by the client where client pay for, they consume. This help the end user organisation not to manage the software, security issues, latest software updates and many other operational issues for the application to be up and running. Some of the common security issues that a client needs to look before finalizing the service provider would be [16]

1. Data breach
2. Login hack
3. Ransomware [17]
4. Shared instances
5. Application Programming Interface (APIs) [18] not secured
6. Latest updates or patches for the software currency

PaaS

Cloud service provider enables the ability to the enterprise or clients to build and deploy their own custom created applications using the standard tools and programming languages. Custom build application service is not controlled by the service provider provided client choose to take the standard applications that are available from the service provider. In addition, the client has to ensure that they adhere to the standard need of the underlying business infrastructure that includes operating system, backup, storage and the servers [19]. Client should also have to ensure that the applications that they have built on their own need to be working with the Integrated Development Environments (IDEs). Big data [20] and Cloud computing are so tightly integrated as the data is generated by the end users for the platform to handle. Handling of Big data without the optimized environment could lead to SLA [21] failures on the service provider to deliver the service. As shown in Fig. 3 it is simulated for a client who had provided the target SLA metrics against the achieved in PaaS. Some common concern that prevails in the space of PaaS were:

1. Vendor lock-in
2. Deployment restrictions on Cloud models
3. Restricting to one environment
4. No open source

IaaS

Today datacentres usually have many different hardware resources for running their applications that typically get deployed in the infrastructure environment. This deployment could be from a single codebase. One such type is large physical host running with Virtual Machines (VM's). Such large physical host have larger amounts of Central Processing Units (CPU), Random Access Memory (RAM), Storage allocation, Network Interface Card (NIC), Multiport switch.

There are often or mostly not all allocated CPU's, RAM and Storage are utilized but go unnoticed for the consumption cost as wastage. Memory and CPU utilization are to be more monitored on the cost effectiveness for those VM's hosted which are not properly utilized, where come the resource optimization. Fig.4 show how a server been managed and analysed via the real time simulation.

There are ways how we need to optimize the usage of resources considering their scalability and consumption. It is not only that is asked for the infrastructure optimization but also the Software and Platform optimization which is required to address the need of business. There could be unforeseen issues that need to be deep dive for the effective usage of IaaS. Various resource optimization algorithms have been in place for the infrastructure monitoring system for datacentre's but with a limited approach on the resource optimization on Cloud. Some examples of algorithms [20] that are currently in usage like top-k query, Bitmap Indexing. The commonly used bitmap compression algorithms include WAH, PLWAH, CONCISE, EWAH, and Roaring bitmaps. Fig.5 show how a CPU utilization that is managed via the real time simulation [26]

BENEFITS

Gaining insights into negative trends and anomalies in your IT Service Management environment and infrastructure makes it easy to take proactive steps to:

- Reduce Operational Costs
- Increase Mean time between Failures
- Avoid Service Outages
- Improve Operational Efficiency

Cloud Models [21]

In the recent survey it is inferred that major or large enterprises are moving out of traditional data centre approach to Cloud Transformation factoring to various reasons:

1. Capex
2. Monthly Recurring Cost (MRC)
3. Strategic cost
4. Hardware Depreciation cost
5. Software management cost

To overcome these factors, it is necessary that the organisation need to firmly decide on which cloud platform do they need to sail. There are options that could choose by the enterprise based on their business need like Public, Private, Hybrid and Community. There are multiple vendors IBM, Google, Amazon, Microsoft Azure, Ocean, Oracle, HP, SAP, VMWare who are providing the hosting services to the end users.

Public

The infrastructure is entirely owned by the cloud provider. Resources that are consumed in this Public Cloud like Applications, Space consumption are made available to clients via secured internet. This model is easy and no big expense to clients who would like to be on the public cloud as they don't need to think about the hardware, application, scalability, backup, storage costs as these are managed and provided by the vendor. In this model the databases are made common, Cloud native databases (CNDB) [22] as they could be easily managed by the vendor for easy scalability, elasticity, and on- demand usage.

Private

The cloud infrastructure is hosted based on the client requirement in specific business need, as stated operated by a single entity. It gives organisations a direct control on their data which could more secured. Sectors like Banking, Legal prefer to be in the Private cloud considering their security issues [8]. This model serves to a limited number of clients behind the secured firewall. In this approach client can decide on choose and pick on the services that they may require in this service model.

Hybrid

Hybrid clouds are a mix of two or more cloud (Public, Private, Community) that could be customized to have unique entities that are bound together offering advantages of multiple deployment models. The disadvantage over the Hybrid model is on the scalability, security as this is a semi- shared environment with other clients.

Community

Community cloud is a multi-tenant service model that is shared among several clients or organisations. Community cloud majorly fall under the combination of private cloud those that are combined with similar objective in business need.

III. LITERATURE REVIEW

The relevant systematic literature review in this research study that had been put in, highlights of their research analysis had covered Software as a Service (SaaS), Platform as a Service (PaaS) predominantly. The majority of the studies focus on measuring or improving or adopting different approaches in SaaS, PaaS and some research papers cover the migration strategic of Cloud but not focused bigger on the Infrastructure as a Service (IaaS). For this purpose, it is inferred that very few research analysis cover on the Infrastructure as a Service (IaaS) with certain limitations on their own models that they have developed to optimize their own platform. There has been no focus on server optimization either on their resources, un-utilized storage. No big recommendations have been provided on the resource optimization for better enhancement for server optimization. Some research papers cover on the VM efficiency improvement but significantly not covering on the server optimization for better improvement. This research narrows down towards the gap that had been identified in Infrastructure as a Service (IaaS) restricting towards the server optimization on cloud. Below Table 1 provide a better understanding on the literature review justifying the need for IaaS with a detailed comparison among the recent research surveys in the cloud computing server optimization.

TABLE 1. COMPARISON OF THE PROPOSED APPROACHES BY PREVIOUS RESEARCH

Author name	Year	Proposed title	Feature	Platform (Service Model)	Research gap
[1]Salmon et al., 2022	2022	Cloud Computing at Unitech	Research majorly contributes to the SaaS and their associated benefits in the Cloud computing	SaaS	There is no big analysis on IaaS
[2]Keyan et al., 2020	2020	An Overview on Edge Computing Research	Contribute towards the Edge computing in the SaaS and IaaS	SaaS and IaaS	Coverage of IaaS is very less and not addressing all the issues that the current infrastructure undergo.
[3]Irina et al., 2022	2022	Cloud Computing Models for Business	Paper is covered in high level of all the models of cloud computing pertaining to specific business	SaaS and PaaS	IaaS is not covered extensively
[4]Josh et al., 2022	2022	80+ SaaS Statistics and Trends	SaaS is the major contribution of this research analysis analyzing their statistics and trends for simulating the business improvements	SaaS	IaaS is not focused for any of the business need
[5]Mendonça et al., 2019	2019	Evaluation of a Backup-as-a-Service Environment for Disaster Recovery	Research paper touches the IaaS service but much focused on the Backup issues and their related coverage via the Disaster recovery management contributing to SLA calculations	IaaS	IaaS is just a part of this paper but not had an opportunity to speak on the optimization of resources that are in the infrastructure.
[6]Berisha et al., 2022	2022	Big data analytics in Cloud computing: an overview	The contribution of this paper is more into Big data and how they are handled	SaaS, PaaS	As Big data has a significant role on IaaS to handle large volume of data, infrastructure is needed to be optimized and robust which is not

					covered in this research.
[7] Sparsh Verma et al., 2022	2022	Survey Paper of Cloud Computing	Overall Cloud computing covered in this research paper	Cloud Computing	No extensive coverage of any of the Service model topics where this research analysis paper is looking for IaaS Optimization
[8] Shi et al., 2022	2022	AWESOME: an auction and witness enhanced SLA model for decentralized cloud marketplaces	Most of the area that had been discussed in this paper is on the SLA model and their benefits based on the decentralized approaches	SaaS, PaaS	IaaS also has an SLA, SLO, KPI negotiations which is not covered in the analysis.
[9] Tomarchio et al., 2020	2020	Cloud resource orchestration in the multi-cloud landscape: a systematic review of existing frameworks	Entire paper is analyzed on how the cloud orchestration can be done for a multi-cloud platform like moving servers using containers. This paper also covers multi-cloud vendor platform in the infrastructure	IaaS	IaaS is focused limiting to multi-cloud orchestration and not on the optimization.
[10] Azma et al., 2021	2021	Research and Development on Cloud Computing	This paper covers all the cloud provider capabilities and how multi devices are operated via Cloud	Cloud Model	SaaS, PaaS and IaaS are not covered exhaustively and in particular to IaaS there is no focus.
[11] Joel et al., 2022	2022	Agile logic for SaaS implementation: Capitalizing on marketing automation software in a start-up	Research analysis mainly focus on SaaS and very less on PaaS, IaaS	SaaS, PaaS	IaaS being a key factor on the Cloud computing, no recommendation on optimization
[13] Al-Said Ahmad et al., 2019	2019	Scalability analysis comparisons of cloud-based software services	This research paper contributes on scalability performance measurement against Software services. Give some clue on IaaS but not exhaustive	SaaS, IaaS	Give a better outlook on IaaS performance restricting towards specific vendor who are in the current market
[14] Mulahuwaish et al., 2022	2022	Improving datacentre utilization through containerized service- based architecture	Paper covers the monolithic approach on IaaS	IaaS	It is restricted to one particular service provider AWS on IaaS which is not covered for all the IaaS server optimization
[18] Muhamed et al., 2019	2019	CASE STUDY FOR MIGRATION FROM ON PREMISE TO CLOUD	This research paper cover on the migration approach from on premise to Cloud	Migration strategic	No major contribution on any of the Cloud Models and especially towards IaaS
[19] Zhang et al., 2022	2022	JSON-based control model for SQL and NoSQL data conversion in hybrid cloud database	This paper covers the databases and NoSQL approach in the Cloud	PaaS	IaaS is not in the scope of this paper
[20] Yinghua Qin et al., 2022	2022	Faster Multidimensional Data Queries on Infrastructure Monitoring Systems, Big Data Research	This paper cover the IaaS based on multiple Virtual machines in the particular host.	IaaS	Better algorithm tuning on server optimization is required
[22] Feng et al., 2022	2022	A maturity model for AI-empowered cloud-native databases: from the perspective of resource management	This paper discusses about the native databases that are empowered via AI in the Cloud	PaaS	IaaS is not focused for better performance optimization
[23] G. Sukhpal Singh et al., 2022	2022	AI for next generation computing: Emerging trends and future directions,” Internet of Things	Research majorly contributes to the SaaS and their associated benefits in the Cloud computing	SaaS	There is no big analysis on IaaS
[24] W. Andy et al., 2021	2021	Google Workspace: A cheat sheet	Research analysis focus on SaaS and their improvements	SaaS	IaaS is not covered for better results on server optimization
[26] Pal, D et al., 2022	2022	Mitigating the free rider problem in the distributed cloud based on Key, Participation, and Incentive	Research paper concentrate on multi cloud IaaS sharing or resources over the P2P network	IaaS	Had not seen any focus on server optimization in IaaS
[28] Z. Josh et al., 2022	2022	The future of SaaS: Is there light	SaaS and their improvements were mainly focused on this research analysis	SaaS	IaaS is not covered for better results on server optimization
[29] J. Vanacek et al., 2022	2022	The Social Impact of Cloud	More focus on SaaS and their improvements based on SaaS optimization methods	SaaS	IaaS is not covered for better results on server optimization

[31] M. Mbasa, Joaquim et al., 2021	2021	A Review of Evolutionary Trends in Cloud Computing and Applications to the Healthcare Ecosystem	This addresses the specific healthcare domain in the analysis of SaaS and PaaS entity	SaaS, PaaS	IaaS is not in scope of this research analysis
[32] Yan et al., 2021	2021	Edge Computing Based Data Center Monitoring	Some portion of Data Center management is covered but SaaS been their primary objective of improvements	SaaS	IaaS has limited scope of this research analysis
[34] Sunita, Mahajan et al., 2021	2021	Tools for Cloud for Resource Management	Research paper concentrates on the networking tools and their approaches like NOVA, SNMP	SaaS, PaaS and IaaS	IaaS networking or server optimization using this tool have not been discussed.
[35] S. Hanan et al., 2020	2020	Cloud Computing Virtualization of Resources Allocation for Distributed Systems	Research paper provide details on Virtual machine resource allocation	IaaS	Even though it narrates the VM's resource allocation but haven't covered the server resource optimization for better resource allocation
[36] S. Kavita et al., 2020	2020	Enabling Edge Computing in an IoT-Based Weather Monitoring Application	Cover SaaS as majority of analysis in the IOT specifying to one particular domain	SaaS	IaaS is not a part of this research analysis

IV. RESULT AND DISCUSSION

Based on the above literature survey it is observed that the line of further analysis would be more into the IaaS. It noted that most of the analysis are carried out in SaaS, PaaS and very few research analysis in IaaS. Hence the scope of the research may fall under the category of server optimization environment.

V. CONCLUSION

As there are drastically growth in the Cloud computing it is now the need of the hour to focus on the analysis of cloud migration or transformation for any enterprise to move away from traditional data centre model to Cloud. As we observe the growth rate is higher comparative to each year it now, we need to focus more on managing the cloud environment as the market is growing at a higher rate each year. As it is evident from the survey that we could understand that major IT service providers are more concentrated on Software as Service, Platform as Service on serving the end client. It is evident that very few service providers serve for Infrastructure as Service. Table 1 shows the comparison study of recent research survey recommend focussing on the IaaS. It is not only that Cloud Transformation is having a major role on SaaS and PaaS but also a major role for IaaS to contribute. Since there is more focus towards SaaS, PaaS and research analysis available in the current environment, further analysis on the research would be focusing on the IaaS and its options for benefiting the services which could lead to server optimization in the infrastructure environment.

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VI. HELPFUL HINTS

A. Figures and Table

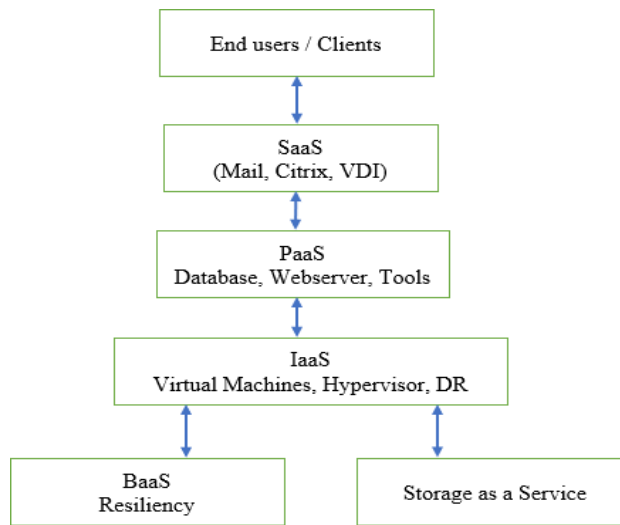


Fig.1 Service model Architecture (SaaS, PaaS, IaaS)

Table 2

ON-PREMISES	CLOUD COMPUTING
High dependency on service provider	Easy option of switching between Cloud service providers
Pay High based on the number of units procured. Less Scalable	Pay for what you use [9],[13] Scale up=Pay more Scale Down=Pay less
Huge Space for servers	No server space required
Need team for hardware and software maintenance	No experts / minimal support required for hardware and software maintenance by the service provider
Less Data Security	Better Data Security
Less Chance of Data recovery	Disaster recovery [32]
Low availability	High Availability
Lack of flexibility	High flexibility
Downtime required for software updates	Automatic or some less software updates
Data can't be accessed remotely	Data can be accessed and shared anywhere over the Internet
Takes longer implementation time	Short implementation time
Migration is cumbersome	Easy interoperability [30]

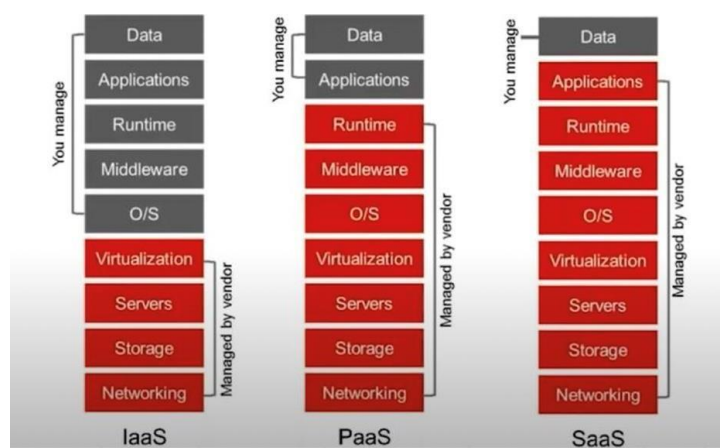


Fig.2 Service Model ownership

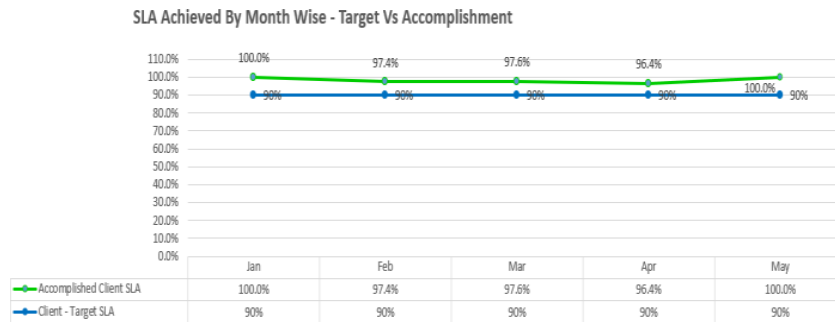


Fig.3 SLA achievement against the target

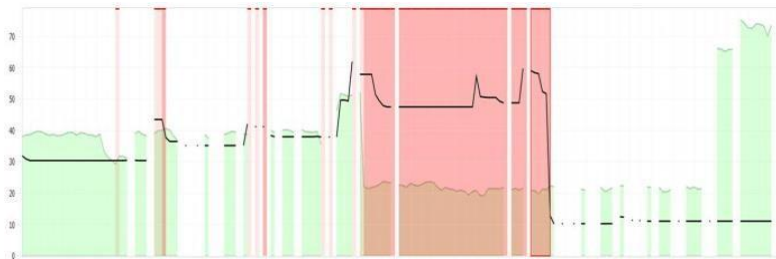


Fig.4 CPU trend analysis

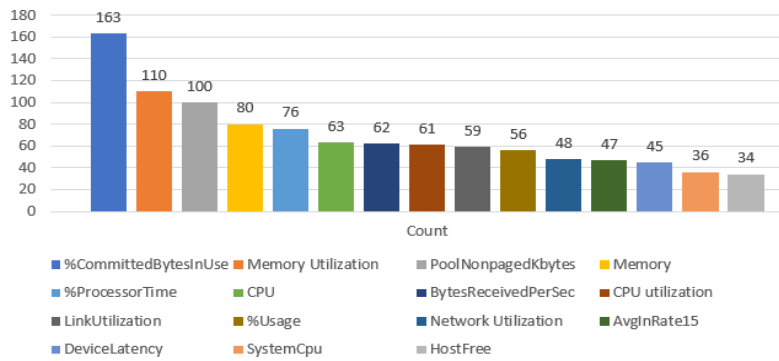


Fig.5 CPU utilization analysis



Fig.6 Cloud models [9]