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Intelligent Resource Discovery in Cloud: A Texanomical Approach to Identifiation of Challenges and Oppertunities

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Abstract

Cloud computing is a type of computing in which various cloud consumers demand verity of services as their dynamically changing needs. It is very difficult for cloud provider to avail all the demanding services. But due to the availability of finite resources it is very difficult for cloud provider's perspective cloud resources must be allocated in a fair manner. So it is a vital issue to meet cloud consumers to provide quality of service requirements and satisfaction. This paper mainly addresses the key performance issues, challenges and techniques for resource discovery in cloud computing. It also focuses on the key issues related to these existing resource discovery techniques.

Keywords: *Resource Discovery, Service Level Agreement, Virtualization, Cloud Computing.*

Introduction

In last two decades, distributed computing invented and enable common user to perform amount of computing. This paradigm brings a revolution in society. This makes internet so fast and available to larger population, about 3.7 billion internet users and growth rate is 7.5% per year. These people are producing 2.5QB of data over different computing platforms such as social media, search engines and email services (Blesson Varghese, Rajkumar Buyya 2018). These platforms not only store this data but also analyze and generate handsome information. All these procedures required huge machines for this purpose. Unfortunately, we have very less amount of equipment than our requirements so we have to go for unconventional ways to do work. We have multiple methods to perform distributed processing and we provision to multiplexing of different kind of workload over data processing machines. Initially, web was introduced that provide some online services such as storage, information translation and data sharing, but now many things required.

The cloud system performance depends on resource discovery some paper have been provided so for and each review paper has its classification In this paper presents a systematic literature review the available review paper has weaknesses and one of the objective of this paper is to cover the weaknesses of these papers explaining the research methodology analyzing and comparing the existing review paper in the field of resource discovery mechanism presenting statistical information about the status of the RD (resource discovery) in cloud computing listing more challenging to propose a RD mechanism and provide more topics for future research and presented in this paper to cover the weaknesses. This paper is also tries to cover the gap between the status of the existing RD mechanisms and mechanism needed.

Cloud Environments

According to Nation Institute of Standards and Technology, "Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics, three service models, and four deployment models." (Mell & Grance, 2011). This definition is very clear about the structure of Cloud. Still this date, many cloud computing systems consist on huge centralized data centers occupied by tech giants like Google, Amazon, Face book or others but computing requirements increasing day by day and these requirements encouraged the researchers, technologists and inverters to do more. Now cloud computing consist on different architectures.

Data Center Cloud Computing

The conventional cloud computing was introduced to enhance the services of Web and Distributed computing. Initially cloud was used for three purposes, IaaS, PaaS and SaaS but over the time more services were added to cloud such as Network as a Service (NaaS), Storage as a Service (STaaS) and finally, everything as a Service (XaaS). Different cloud users use one or multiple services according to their needs.

There are three basic cloud deployment models. In *Private Cloud*, an organization will not share its resource publicly to some other organization or people. Computing resources will be utilized for its own purposes. This is cloud is more secure efficient due to constraints and easy to manage. *Public Clouds* are deployed for common user services. These are most popular deployment because common user is not able to install and manage huge number of machines to achieve its desired output. Public cloud charges the user as peruse where user will access required resource for its demand. The hybrid cloud has both aspects, public and private.

Infect these are public clouds which are available for private use. Some part of the machinery is shared but vendor also guarantees some of these resources will not share to other users and they will remain dedicated for specific customer (Lawton, 2012). Synergy declares in third quarter of 2019, worldwide hyper scale centers crossed 500 marks in numbers. Most important features of these data centers are, these are capable of managing huge amount of data. These centers work as backbone of Big Data. Similarly, these data centers are also largest cloud vender and able managing hundreds of thousands of individual and corporate clients.

Mobile Cloud Computing

In the first decade of 21 century, mobile devices available on large scale. These mobile devices are not only electronic devices but they are smart devices like computers. They have connectivity medium and stored program architecture. These two organs made them a trustable computing resource. In contrast of conventional cloud data centers, MCC required no large stack of machines and management system. MCC can be generate on Ad-hoc bases and help us to perform relatively small and quick tasks. Mobile Cloud Computing (MCC) obtained USD 24.51B till 2019 and growth rate will remain 25.28% up to 2024(https://www.mordorintelligence.com, 2018).

The picture shows clearly that Asia and Pacific region will be fastest growing markets for MCC while US and EU will be at middle because these countries already enjoying the peak already.

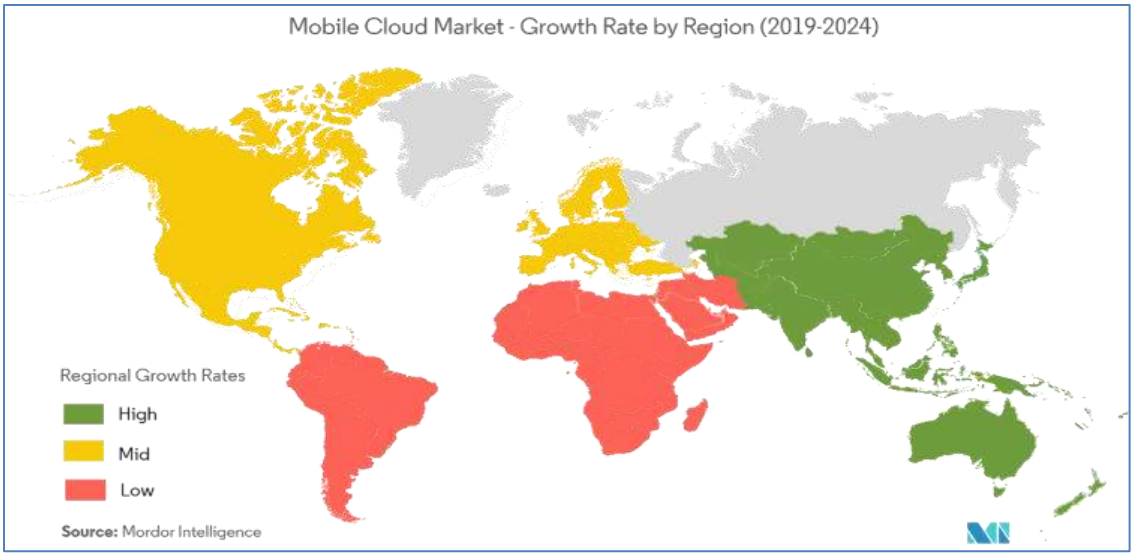

Figure 1: Worldwidegrowth rate of MCC up to 2024

Fogging

Fogging or Fog Computing or Edge Computing was introduced by Cisco in 2012. In fogging we use edge devices to achieve large amount of computing. With support of Internet of Things (IoT), fog enables to perform task which required proximity, objectives, and resource pooling and latency reduction. The cumulative annual growth rate will remain 55.4% from 2018 to 2025(Research, 2019).

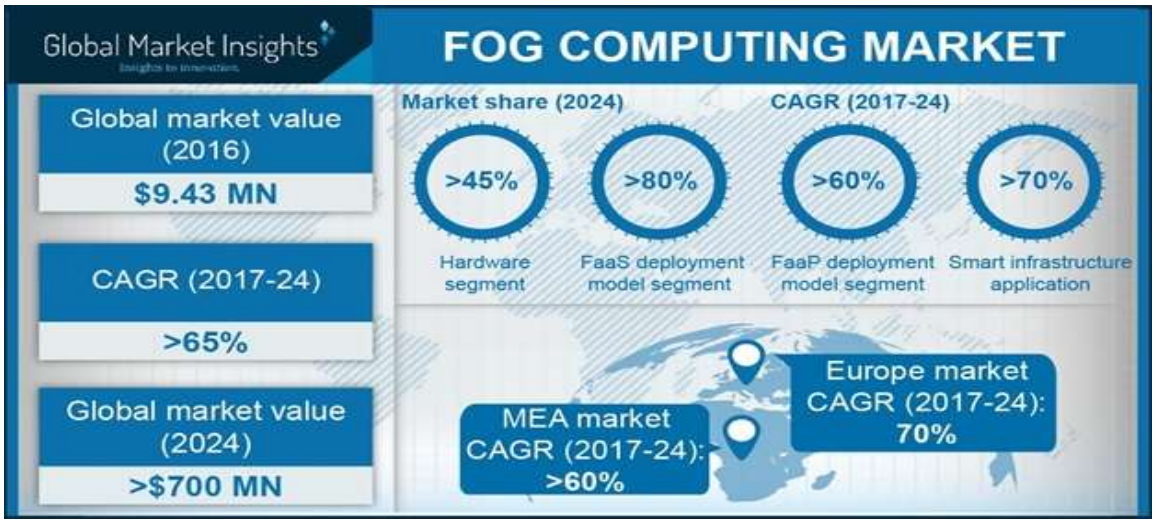

Figure 2: Expectedgrowth of FogComputing

Cloud Federation

Federated cloud can be constructing with integration of multiple clouds. For this purpose, different cloud vendors produce an agreement which defined the terms and condition of this collaboration. The basic idea of cloud (pay as peruse) will also form the foundation of agreement. This method produces the scalability of existed cloud.

IoT Cloud

We are entering new age of digital devices. Most of the devices are small and smart. They can process their data themselves and also, they can be integrated in the form single larger computing machine which acts like a Cloud (accessible, configurable and virtually available everywhere on demand). Markets and Marts announced the expected growth rate will be 30.6% by 2021 and cumulatively $7.15b (https://www.marketsandmarkets.com/, 2016) and still this is start of this new technology that overcome the rest of the other computing facility at larger scale.

Resources in Cloud Computing

All environments and structures of cloud computing have resources which are required on demand. Description of these resources is following.

- **Processing**

Processing power is the foundation necessity of computing machines. Whenever we deploy a cloud, the ultimate requirement is proper processor scheduling and every client of cloud must be satisfied by availability of computation resource.

- **Energy**

Every device and component required energy to perform its operations but energy effects cloud system in several ways. The most important aspect is energy cost. As we are going to more power hungry in computation means and we are getting more dependent on energy resources. No doubts, we are more investing in renewable energy resources but it is also important that we still hugely dependent over thermal resources (Aljamal, R., El-Mousa, A., &Jubair, F. (2018)). Thermal energy directly associated with fossil fuel and prices of such fuel are attached with multiple aspects. First one is fossil fuel is limited and will end someday. As Middle East is most important area of oil and gas production, politically unstable. Any political chaos and disturb the fuel prices and these ultimately affect data center running cost. Although IoT cloud is not directly affected with fuel prices because they hugely dependent on dry batteries but these batteries require charging after a while. Besides recharging, the recharge cycle is also important. A nonregulated bunch of IoT devices exacted soon and demand recharge. Every recharge cycle decreases the life of battery and can produced extra cost. Only data centers in US using 90 billion kWh and this will jump to 140 kWh in 2020(Aljamal, R., El-Mousa, A., &Jubair, F. (2018)). Similarly, the energy consumption increases the carbon emission and generates huge threats for environment. Worldwide CO_2 emission will be 340 megatons up to 2020. Heat is another form deception of energy and permanent cooling setup required to establish on keep the devices calm and healthy nonetheless they are small devise like Fog, IoT or hyper scale data center. A rough estimate to setup a cooling system for medium level data center is $4-$8 million. This setup is not only having establishment cost but also have running cost. Air conditions, fans and water circulating pumps required extra energy to run.

- **Price**

Price affects the Cloud Computing in three ways. First the cost of energy that consumed by machines. Second is cost of bandwidth and third one is running cost. We already discussed the cost of energy in previous section. The second aspect is network cost which will be managed by ISP's. As cloud is available at network all the time so network will available every time either it is required or not. ISP charge network cost in terms of data transfer and also in setup charges and line rents. To reduce the network down events, the cloud vender has to setup network with multiple ISPs. More network connection means more networks cost. As cloud promises about scalability so as client increase workload the network cost also increases and vender have to manage these factors. It also important that network cost is not steady and linear in parts of

world. Whenever system will receive a workload, the resource manager must have considered the network costing packages.

System running required human and technical resources and miscellaneous and as setup increases, these resources might be increase exponentially. Government taxes, land rents and physical security is required to keep the system running.

Digital security also important and cloud vendor have to establish a security that protect the data from breach, intruders and lost. Every client might not have satisfied with regular security setup then it can demand special security so venders have to bear extra cost to run the system and customer satisfied. Digital security is continuous procedure that demand to upgrade over them time. Security software required renewing the licenses, malware immunity demands regular updates and intruder detection wants research and development.

- **Memory**

Currently the cost of memory is not exponentially increasing in hardware but amount of memory still an important part of computing complexity. Larger memory means good processing speed as well as processing larger amount of data.

- **Storage**

Storage prices have very less exponential growth but the amount of data over the internet increasing rapidly. A large amount of data post on social media and this data goes on cloud.

- **Network**

Cloud resources are available virtually and if cloud machines are dispersed geographically then network is ultimate requirement.

- **Virtual Machines**

Whenever a client interacts with cloud, it feels like a dedicated machine with own CPU, RAM, storage and OS but in reality, these resources might be part of a single or multiple machine. Another technique also used by Google Cloud that is *Container*. *Virtual Machines (VM)* or *Containers* can be configured, migrated or consolidated on the fly (Brumec, S., &Vrček, N. (2013)).

- **Nodes**

Every cloud is a pool of configurable devices. These devices are called nodes. Configuration manager allocate these resources to some client during process due scaling and load balancing or some other optimization strategy (Divya, K., &Jeyalatha, S. 2012).

- **IO Devices**

In conventional cloud, IO devices were not the part of infrastructure. But *Fog* and *IoT*upgrades the strength of cloud. Now cloud can ascertain the data not only from human clients but also from small devices and sensors and application on cloud can process it and further send the results to some other devices.

Goals of Resource Allocation

Resource allocation is an umbrella term. Whenever we perform better at resource allocation, many other areas effect too. This section explains these areas, which are the outcome of resource management.

- **Energy Optimization**

This is most discussed area of resource allocation. Every now and then, proper resource allocation produces optimized results in energy consumption. Data center energy cost is become double in every five years. Energy is not only the issue of processing power. It also consumed in disks, networks and all most heavily in cooling system. All things in energy directly belong to resource allocation scheme.

- **Cost Effectiveness**

Second most important output of resource allocation in cloud is running cost of the system. Most of cost impact is belongs to energy because amount of electricity bills of data centers in only US approach to $11.5 billion. Network bandwidth another cost effective aspect of cloud. Resource allocation also affects the bandwidth and proper allocation reduces the network cost. Cloud data centers, which are geographically dispersed, have great vow to use locally (Li, J., Yao, W., Zhang, Y., Qian, H., & Han, J. 2016).

- **Scalability**

User demands fluctuate very quickly. Cloud cannot deny the resources to client because user will pay the amount of these resources and it also a feature of cloud to provide resources on demand. To achieve this feature cloud, manage its physical and virtual resources and allow user to add its workload over the cloud without hesitation.

- **SLA & QoS**

Both of these aspects belong to client satisfaction. SLA is explicit and defines an organic agreement between client and cloud vendor. This document describes the list and standards of cloud resources, which will provide to client. This document also has legal importance. While QoS is implicit and define the non-tangible standards, which will provide to client.QoS is really important because all good will of cloud vendor stands on it (Masdari, M., &Khoshnevis, A., 2020).

- **Fault Tolerance& Recovery**

There would be a chance of failure everywhere. Cloud can fail monitor, discover, provision, allocate, predict, balance and deploy one or more resources due any reason. System should be able to identify the failure and have some capabilities to perform recovery operations if possible. Fault management consists of two phases. First is discover the proper reason of the failure and second is recover mechanism (Masdari, M., Nabavi, S. S., &Ahmadi, V. 2016).

Procedure and Methods of Resource discovery

Good resource discovery is an import task for cloud vendors because it enables a cloud to satisfied a large number of customers and also it helps to reduce the operational cost (Mohammed, J., Lung, C.-H., Ocneanu, A., Thakral, A., Jones, C., & Adler, A. 2014). How a cloud can achieve a proper resource allocation? Consider that there are multiple methods to achieve optimal resource allocation and a cloud system can use one or more methods at a time.

- **General Procedure**

The general mechanism is simple. It consists of four operations. These keep eye on cloud and user demands and adjust the provision. Details are following.

- **Resource Monitoring:** This part watches the cloud activity. Monitoring system lists all the resources of a cloud and also generates the logs of usage. Monitoring is fine grained process because all the things must be recorded and system considers any kind of resource leakage. Resource log also updated when resource released by user.

- **Workload Monitoring:** In section 5, we will discuss different kinds of workload on cloud. Every kind of workload produces different pressure on system. Workload Monitor keep eye on user demands and generate logs.

- **Analyzer:** This is main decision maker component which take information both resource monitor and workload monitor. This part keeps provisioning policy. All the research over Resource Allocation Policy belongs this component.

- **Provision Manager:** Analyzer generates a list of optimal assignable resources. The provision manager handover these resources to user. Provision manager takes care about over or under provisioning.

Methods

In this section will discuss general methods, which adopt to find best resource allocation mechanism. The Analyzer finds the operation to set a proper technique but which method will execute when, this is also a great challenge.

- **Virtual Machines, Containers and Para Virtualization**

We have limited physical resources in terms of processing, memory or storage. At this point we produce some augmented resources that satisfy the users and engage them as a physical machine but these are actually physical as they seem. These are virtual resources. Infect three major methods to produce virtualization. First, one is Virtual Machines. Whenever, a user demands some resources on cloud then a virtual machine is setup. It contains CPU, RAM and OS. User uses this machine like a physical machine. They install applications, databases servers, and web servers; deploy web services and many more on it. This is similar to purchasing a computer. The virtual machine is handy because it allows running different packages on single physical CPU with complete isolation. *Hypervisor* is a tool that generates and monitors virtual machines (Shea, R., Liu, J., Ngai, E. C.-H., & Cui, Y. 2013). This might be software or hardware. Containers are another method to get application isolation. Docker is one of the most popular container technologies that enables user to achieve virtualization. Both virtual machines and containers have pros and cons in different aspects. Containers changed the cloud service model little bit. PaaS is one of three fundament service models which are normally listed with cloud but container converts it to CaaS (Container as a Service). There are certain differences also between both PaaS and CaaS because PaaS also can provide you a development environment such as AWS Beanstalk which not possible in CaaS. In CaaS you have only deployment of applications. In some cases, both works together and this is Para Virtualization. If you developed an application on PaaS and then deploy at CaaS then you are using both collaborations.

- **VM Migration**

Virtualization really a handy technique to reduce the cost of physical machines. Another byproduct of using VM is that a process can migrate one physical machine to another with its complete context. Migration

procedure can be adopting to any reason just like heavy workload on current physical machine or cost of network is high that can be reduce to shift the workload on nearby location. Virtualization can be achieved by containers or virtual machines. Both approaches have pros and cons. (Taghipour, M., Soofi, M., Mahboobi, M., &Abdi, J. 2020).

- **VM Consolidation**

As we distribute a single machine in to many virtual machines then virtual machines can be consolidated and convert it into single virtual machine.

- **Load Balancing**

Due to scalability and cost issues, server should always be balance with workload. Proper resource allocation allowed server to obtain the balance. Resource monitoring, discovery, provisioning and VM migration allowed a balanced fate to server.

- **Interoperability**

Distribution of a single job on multiple cloud nodes for fast is the process of interoperability. Cloud must be enables to interoperability over the geographically dispersed nodes and must enable to perform jobs so fluently that customer realizes smoothness of workflow. It is correct that interoperability produces lot of network overhead but many times it is important to managing the workload and provides balance to overall cloud server. (Vouk, M. A., Sills, E., & Dreher, P. 2010).
Figure 4: Cloud Resource Discovery System

Workload

Workload defines the performance of cloud system. Theoretically, cloud replacing conventional computing so all kind of activities we perform on a desktop or personal computer can be performs over cloud. Some of common activities are following.

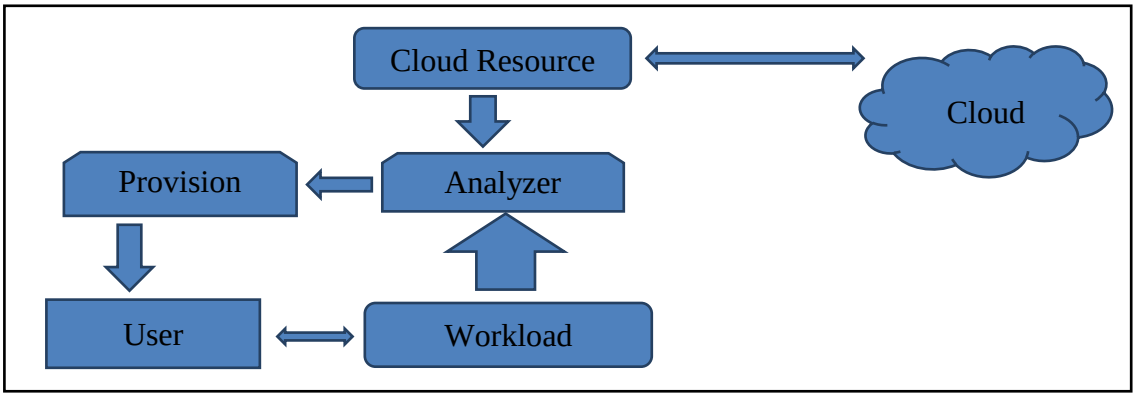

Figure No 3

- **Interactive**

Transactional workload considers to be a small in individual but larger when multiple users perform it. Such as online shopping, bill calculation looks very easy and small but when million or evenbillion of customer try to do it simultaneously. This procedure not only involve large amount of CPU consumption but also required huge bandwidth. Sometimes itrefers as interactive or Ant (P., O., J., P., H., K., & J, S.

2017) some other common examples are search engines where user spent a small amount of time but as customers increase, cloud also under pressure.

- **Batch**

Batch processing required little user interactivity but it includes huge workload. User will be some command and inputs and cloud convert these inputs into an output that might not be a gigantic in its nature but the conversion process includes larger searching and reporting. StackOverflow bring us to question page where many small things such as all answers, acceptability of answers, forum activities and participant behaviors required lot of search and database operations.

- **Calculative**

It's also looks like batch but it required lot of mathematical activity which engages more ALU. Machine learning application which have perform learning procedure and then predictive and classification of data nodes required this kind of workload.

- **Streaming**

Rich media applications required lot of computing and communication power. Cloud is one of the solutions that help users to enable their devices make this process enjoyable. MCC is more proper solution of such tasks. This kind of workload not only involves huge user interactivity and also computation as well.

- **Gamming**

Gamming one of the largest growing industries. New games required lot of data transportation over the network, processing complexity and user interactivity. To perform theseoperation, we required big processing machines. Due to personal interactions, it also required that large processing infrastructure must be available to every person which is really difficult. To overcome this limitation, cloud comes forward. Smart devices use as a thin client while main processing done on a huge data center. Another solution is MCC where multiple devices work together and produce results (Pitchai, R., Babu, S., Supraja, P., &Anjanayya, S. 2019).

- **Real time**

Real time workload normally required time constraint systems such as robotic surgery, auto vehicles and war machines. The system required very efficient, active and dedicated for these purposes. Normally this kind of workload is considered not suitable for cloud because cloud system consists on multiple physical or virtual machines which execute the tasks and generate a collaborative result and these machines might be geographically dispersed, but some workload such as analysis and training datasets might be stored on a cloud and these machines provide backup processing(Pitchai, R., Babu, S., Supraja, P., &Anjanayya, S. 2019)

Pervasive Computing

Pervasive computing helps us to provide computing resources everywhere and any time when we required. Though this computing is not common at this time but we have to require it in future. According to paradigm, we can use sophisticated machines to even house hold item such as TV, AC, ovens even juicer blenders for this purpose.

- **Storage**

As mentioned earlier about the growth rate of data production. Cloud is one the residence of these data. SkyDrive, OneDrive or GoogleDrive are some examples to use STaaS (Storage as a Service). User interactivity is not such often, no huge processing required because user store their personal or official data in files over the cloud and access whenever they required. Normally no large processing required for these files but storage medium capacity and security are important concerns in this service(Hameed, A., Khoshkbarforoushha, A., Ranjan, R., Jayaraman, P. P., Kolodziej, J., Balaji, P., Zeadally, S., Malluhi, Q. M., Tziritas, N., Vishnu, A., Khan, S. U., &Zomaya, A. 2016).

General Techniques to achieve optimal Resource Allocation

Every now and then, cloud resource manager must find a technique that cuts down the cost and increase performance with elasticity. There are multiple methods are available for such operations and hundreds of techniques were discovered and still on research arena. According to (Liang, B., Dong, X., Wang, Y., & Zhang, X. 2020) a large amount of taxonomy is defined but in short all of these are methods are described in following terms.

- **Dynamic Resource Allocation**

Dynamic techniques are also called reactive techniques. The workload analyzer keep eye on workload and resources find and balanced equation to assign the task to proper resource. It is also considered that many of these techniques are not robust as they should be and also the are not compatible on different kind of scenarios and nature of cloud systems. Dynamic techniques are also attached with some parameters such as power, cost, load balancing, priority, utilization, response time, and throughput, SLA or QoS.

- **Predictive Resource Allocation**

Predictive resource allocation techniques are new and unconventional approach. These use machine learning algorithms to find the usage patterns of clients and resources and prepare resources according to that pattern. There huge pros of these techniques. These are robust, future oriented and adjustable with multiple parameters but at the same time they can be failing if usage patterns changed unexpectedly. At the same time these are itself processing extensive because they analyze the usage logs frequently. Sometimes usage logs huge enough and might be part of big data and required more processing power to perform analysis tasks.

Cloud Evolution over the time period (Picture)

Goals VS Methods

There are certain tradeoffs between goals and methods because methods also can produce overhead for the cloud system. Some of the tradeoffs are following.

Table No 1: Resource Management System

Cloud User		
ResourceDiscovery	**Resource Allocation**	
Resource Reservation	**Resource Prediction**	**Resource Scheduling**
Administration		**Resource Monitoring SLA and QoS**

Resource Management System Modules Resource Discovery: A resource discovery is a process of finding the proper resource for the user request.

Resource Allocation: The resource Allocation use to avoided from the resource fragmentation, overloading of resources and resource contention to be effective.

Resource Predictions: The resource predication uses mathematical mechanisms such as heuristic analysis of task to predict future required resources and provide analysis of results.

Resource Scheduling: This ranks the requests by priority, profitability or other parameters, and then in turn provides the resources that user have request.

Balancing and Cost: The load on the resources of a cloud data center to prevent some issues such as overloading resources.

Workloads VS Clouds: In this section we will discuss which kind of work is mostly use for which cloud type.

Table 2: General Cloud Description

Type	Conventional	MCC	Fog	Federated
Interactive	Good	Good	Worst	Best
Batch	Best	Bad	Bad	Best
Calculative	Good	Worst	Best	Best
Streaming	Best	Worst	Good	Bad
Gamming	Bad	Best	Good	Worst
Real Time	Worst	Bad	Bad	Worst
Pervasive	Bad	Good	Best	Worst
Storage	Best	Worst	Bad	Good

Table 3: Properties of Clouds

Aspect	Variety	Description
Resource correlation	Homogenous	All nodes have similar kind of resources including CPU cores and their speed, main memory, storage and network bandwidth and operating systems
	Heterogeneous	Multiple varieties in resources such as different CPUs with different architectures, operating systems and other resources
Proprietary	Public	Cloud resources are available for public (paid or free or shared)
	Private	Completely private for an enterprise
	Hybrid	Generally private but some extents are available for other customers (Paid or free or mixed)
Ownership	Single	Cloud owned by single organization
	Federated	A Cloud may access to other Clouds to extends its services
Location	Single Data Center	All nodes are situated in a single location
	Geographically dispersed	Nodes are distributed and connected by internet or some other kind of network

Resource Distribution Method	Virtual Machines	Some Cloud vendors use virtual machine method. It requires a hyper visor
	Container	Some venders use containers. It does not required hypervisor
Services offer (Cloud is not limited to provided list)	IaaS	Infrastructure as a Service
	PaaS	Platform as a Service
	SaaS	Software as a Service
	NaaS	Network as a Service
	XaaS	Everything as a Service

Table 4: Summery of Literature Survey

Reference	**Methodology**	**Resources**				**Limitation**
		P	M	S	N	
(Vijindra et al 2020)	Bond base	✓	✓			Storage, resource discovery & Network,
Hanikaivel et al 2020	Cold resource				✓	Only , cold resource
(rajalakshmi et al., 2020)	Sine cosine	✓				Only scak mean
(Liang et al., 2020)	MALE	✓	✓			Storage, Network,
(Yazhou Hu et al., 2016)	Kalman Filter	✓				Only CPU,
(Bui et al., 2017)	GPR, CO	✓				Only CPU,
(P. et al., 2017)	MA, K-Mean	✓				Only CPU,
(Liu et al., 2017)	LR, SVM,0-1 IP	✓				Only CPU,
(Al-Faifi et al., 2018)	KDE, NB	✓	✓			Storage, Network,
(Zhao & Wang, 2018)	LS-SVM, VA	✓				Only CPU,
(Zhao & Wang, 2018)	DRL	✓				Only CPU,
(Minarolli et al., 2017)	KDE	✓				Only CPU,
(Ramasamy & Thalavai Pillai, 2020)	M-PCA, H-PSO, MGA				✓	Only Network,
(Mahdhi & Mezni, 2018)	KDE	✓				Only CPU, Only
(V. B. Edwin Joseph et al., 2020)	ARIMA	✓	✓		✓	Storage not study,
(Kholidy, 2020)	PSO	✓				Only CPU,
Pitchai et al., 2019	AIVP			✓		Only Storage,
(He et al., 2020)	MA, ES			✓		Only Storage,
(Z. Chen et al., 2020	RNN	✓	✓			Storage, Network,

Table 5: Comparative analysis on Different Resource Management Techniques.

Refrences	**Technique**	**QoS**	**Utilization rate**	**Scalability**	**Security**	**Energy Efficiency**	**Cost**
Asma et al 2011	Resource	✓	×	×	×	×	×
Morty et al 2020	Discovery	×	✓	✓	×	×	✓
Muzazander et al 2016	Resource	×	✓	×	×	✓	✓
Guang et al 2017	consolidation	✓	✓	×	×	✓	×
Vakilina et al 2015	Resource	×	✓	×	×	✓	✓
Sheng et al 2020	allocation	✓	✓	✓	×	×	✓
Xiaomino 2016	Resource	✓	✓	×	×	×	✓

Aarti et al 2020	provisioning	×	✓	✓	×	✓	×
Syed et al 2017 Shukhpal et al 2018	Resource Scheduling	✓ ✓	✓ ✓	✓ ✓	× ×	✓ ✓	✓ ✓
Feny young et all 2015	Resource bloking	×	×	✓	✓	✓	✓
Gusheng et al 2017	Modeling Resource estimation	✓	×	×	×	×	×
Young et al 2017	Resource mapping	✓	✓	×	×	✓	✓

Statistics and analysis

Analysing the results this paper also provides statistical analysis and identifies more challenges and open issues in the RD field in cloud computing based on our best results which is provided in the reseach methodlogy. This topic is concideared by many papers from 2009 to 2020 in the field of RD in cloud computing is showen in fig. 4(Sahafi, AM Rahmani, PS Mashhadi 2020)

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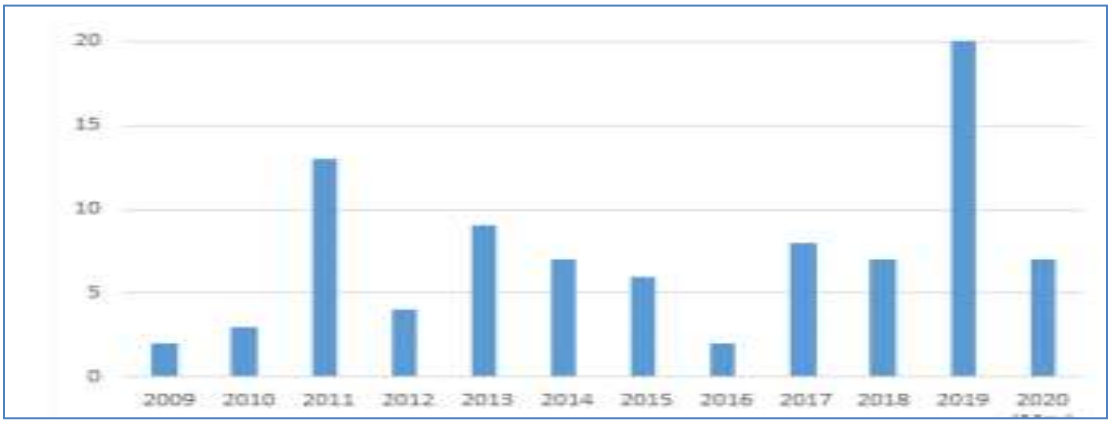

Figure No 3: Research on Cloud Computing Resource Allocation

The various scientific databases have published the resoult of RD research study as shown in fig5 the Elsvvier ACM IEEE Springer and other publisher have covered 30, 39 ,6,5 and 20% respectedly(Sahafi, AM Rahmani, PS Mashhadi 2020).

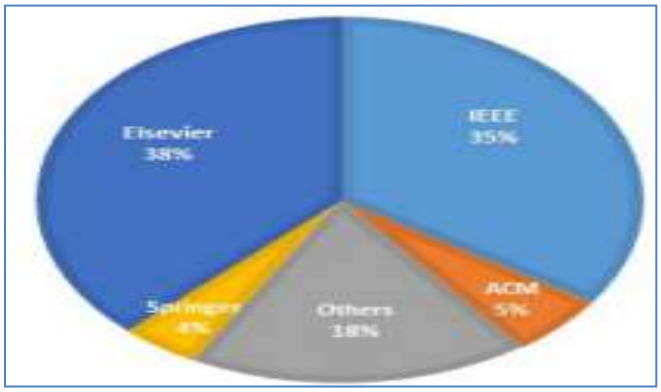

Figure No 4

The nest item is the status of the evaluation tools used in this field. According to our study the reshers have been used 85 % of simulation and 15% of implementations to evaluate the results.

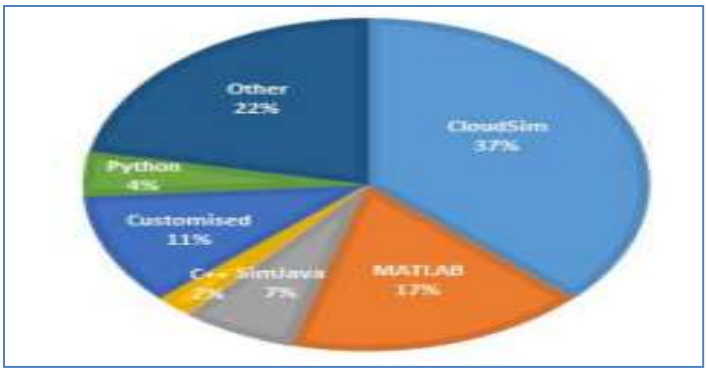

Figure No 5 no of paper published with respect to tool

Acording to our research the existing machanism have covered some challenges resource utilization energy consumption security SLA QoS provided by the user the increase use of cloud computer the importance of RD more efficient machanism are needed.

Open problems in cloud resource discovery

We analyzed the resource management technique issues and discussed their merits such as throughput scability,optimum utilization,quality of service, reduce latency, reduce overheads,computational time and energy efficiency.

These technique demerits are less security, low priority, the system performance degradation due to network delay and more time is used for balancing the workload. We also observing the some unresolved issues which are discuss the blow.

- Performance issues in cloud.

The performance is the important issue between the cloud service providers and cloud user.

- Security issues in cloud.

The security issues in cloud resources can be classified into security issues in SaaS, in PaaS, and Iaas.

- Scheduling in cloud Resources.

The efficitive use of cloud resources we adopt two type of resource scheduling server resource scheduling and processor resource scheduling.

Conclusion

In this paper we have surveyed different cloud resource discovery techniques for clouds. We see resource provisioning, resource discovery, resource monetoring, resource maping and resource allocation. The main purpose of cloud resource discovery techniques is to satisfy the consumer requirements. As dissussed in above there huge advantages in applying resource management tachniques. There are still several issues exist which canbe solved to make the cloud resource discovery more managable and efficient. These challenges are resource performance issues, privacy issue, workload server and processor. The matrices

mentation the CPU utilization reduce the number of SLA violation, responce time, reduce delay, energy efficiency, reduce latency and overhead. In our next paper we will focus on cloud resource discovery based on hybred techniques.

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