A strategy/Model to minimize noisy neighbour effect in Multi Tenant Clouds

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***Abstract*— Noisy neighbour is the anomaly effect caused due to the non availability of resource in a cloud infrastructure. Noisy neighbour challenges are the biggest issue in the multi- tenant cloud structure. In this paper we propose the suitable solution to deal with the noisy neighbour and the way to improve the system resource utilization. This research will focus on certain investigation towards the possibility of minimizing the co tenant noisy effect. The improvements in terms of infrastructure, resource allocations are focused along with this study. This will enable the proper resource utilization factor will in turn improve the quality of service of a cloud.**

***Keywords*— Noisy Neighbour, Virtual Machine, Migration, Borrowing, Quota System**

I. Introduction

Cloud computing has received its significant importance continuously over the past decade in the computing world[6][7]. Peter Mell, NIST [1] defines cloud computing is a platform that enable a on demand convenient access. The access is done with the help of internet[13]. A shared pool of computing resources are allotted for access. This seems to be an effective solution minimizing the management effort or interaction with the service provider [8].The primary advantages of using a third party services instead of setting up own physical infrastructure has emerges out to be the most important advantage of cloud computing. The exclusive IT infrastructure is not required by the user and the on demand paid service is been benefitted by the user. In turn, the providers can improve their economy by giving the same services on available to the wide range of customers.

There are three main cloud computing types, with additional ones evolving software-as-a-service (SaaS) for web-based applications, infrastructure-as-a-service (IaaS) for Internet-based access to storage and computing power, and platform-as-a-service (PaaS) that gives developers the tools to build and host Web applications. The multiple independent instances of users are operated in the shared environment in the multi-Tenant architecture [9]. A cloud contains cluster where the physical data centers are partitioned. This is called Virtual Machines. Across the internet the services are been done. The tenant application is logically configured with the virtual machine [14]. The applications in the virtual machine may compete for the same resource. The resources may be over utilized because of the greedy tenant nature. The Noisy neighbor is a terminology in this field to represent the co tenant. Because of this the available resource becomes insufficient for them to utilize. They monopolize the resources which sometimes impact negatively. This may lead the application to penalize with its performance.

The VM interference risk is also incremented due to the consolidation technique in the virtualized environment. The malfunctioning of the application may lead to the compensational financial penalties[16]. The compensation are provided to the client based on the SLA, Service Level Agreement. As per the report done in the existing systems, some of the big numbers are recorded from giant corporations , due to the delay in the response time of 100 ms, it is observed that there found 1% decrease in the sale in Amazon. Similarly another study says that 20 % traffic is reduced in Google due to the delay of 500 ms in terms of response time. These kind of issues is mandatory to be handled at the perspective of cloud provider. The Virtual Machine container share the resources such as cache hierarchies, CPU resources, memory. This condition prevail the VM machine affect or being affected by similar VM containers[17]. This co tenant issue which prevent the performance and the quality of service is primarily addressed through out this research.

II. Literature Survey

A metered model is seen in the cloud architecture. It can be either single tenant or multi tenant architecture[11]. But for

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the proper and the complete utilization of the IT resources and services, the multi tenant architecture is highly used everywhere. There are greedy tenant nature which prevent the equal utilization of resources by the users and hence it end up depreciating the quality of service of the cloud infrastructure [4][5]. In order to address this issue, in the literature, there are two major categorical solutions seen. Few researches were focused towards avoidance approaches[18][19][20] and few other researches were on the detection of noisy neighbors[21][22]. Our research is focused towards the detection of noisy neighbors and frames a systematical approach to deal with the effect. Few research work in the literature is focused towards the static approaches of traffic analysis[23]. Few other study is based on the machine learning techniques for anomaly detection. Using Support Vector Machines a solution is presented to detect the noisy neighbor[24]. The study presented in[25] use the Random Forest which also claims 99% in its accuracy. Exploring the time series data is presented in [27]. A methodology that uses the convolution neural network is also seen in [26]. Based on the studies, it is found that merely detecting a performance degradation isn't find to be suitable solution. The root cause analysis (RCA) is very important. Though RCA is applied in the existing systems in [28][29], the analysis of the noisy neighbor and resolving the lack in the quality of service is still a gap in the literature.

Software as a Service(SaaS) is the most widely accepted technique in this era, As per the studies made in [2] , the importance of SaaS is clearly highlighted. It is also found in the literature that the SaaS is the more widely accepted method. SaaS has proven to be a successful architecture which is beneficial both at the user side as well as the provider end. They scale up with the economy of scale much higher with this techniques. The maintenance cost is considerably reduced because of the service provider can give the service across the different organizations. The work on this aspect have formulated the idea towards multi tenant infrastructure[12]. Due to the requirement and the convenience of usage, This has become possible by embedding a promising multitenant architecture in the development of SaaS applications[3], Principles of abstraction and virtualization is made very effective in cloud computing. The tenants are the multiple organization here. They are connected across the network with the service providers. The information are stored in the database at the cloud at a common data base[9]. The greedy tenants create the under utilization of resources by few tenants and hence this is detailed addressed in the next sub sections.

Multi tenancy, started in early 1990s.. The ASPs application service providers (ASPs) , on behalf of their customers hosted the application. The same application is shared along the wide range of customers based on their request. This is almost similar to the modern era, multi-tenancy is greatly employed in software-as-a-service models such Salesforce CRM, Office 365, Zoho, Box, Zendesk, Slack, and many more applications on demand. Multi tenancy is also employed in Platform as a Service(PAAS) and Infrastructure as a Service(IAAS) such as windows azure, salesforce force.com and Amazon web services also employ multitenancy[10]. Based on the studies done at the literature, it is observed that the starvation is caused in the noisy neighbors by the environmental set up. Hence the victim application suffers with lack of resources.

III. Objectives Problem Definition

All The major scope of this research is to study the strategies of minimizing the noisy neighbour effect. While setting up a cloud environment, distribution of VM , the resource utilization and the time response has to be focussed. Upon the distributed resource allocation, any kind of inconsiderate allocation will lead to significant effect on the other hand. Effects of noisy neighbour in cloud create challenges and that results in the underutilization of resources by application due to the co tenants.

Furthermore this study is focussed on the multi tenant cloud . Hence study is made on the cause of the noise and the ways to minimize it. The tenant applications are installed on the virtual machines. they are logically isolated as well. Due to the sharing of the infrastructure, the nature of greedy resource utilization of one or more tenant creates the Noisy Neighbour impact the tenant application. so improvisation in terms of infrastructure, resource allocation are being focussed in this study.The solutions to handle the noisy neighbour problem are also presented.

.IV. Technological Framework

The Fig 1 illustrates the general technological framework and as we see that the hypervisor take the role of virtual partitioning the physical available infrastructure. The noisy neighbour represent the co – tenant effect which lead to the overall performance depreciation. The cloud infrastructure is scalable in nature and hence the greedy application over utilizes the resources which lead to the impact with the co-tenant. The major focus towards this research is to identify the cause of the noisy neighbour and formulate a strategic approach to handle the same .

As shown in the figure, the framework consists of number of underlying resource. A number of physical servers are owned by the cloud. Virtual partitioning is enabled in each of the server. This is the VM which is commonly referred as Virtual Machines, they rum on the hypervisor as an emulated computing element. The available physical resources in the cloud are partitioned by the hypervisor virtually. The on demand request are placed by the client on the Virtual Machines and the abstraction of the virtualisation[15] is done and however the resources are shared to be utilized. The application may of different requirements in terms of the

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resource utilization. As per our proposed study in this research, the tenant application in the cloud is grouped as two significant categories. The noisy neighbour and the victim application. Based on the survey made in the state of the art

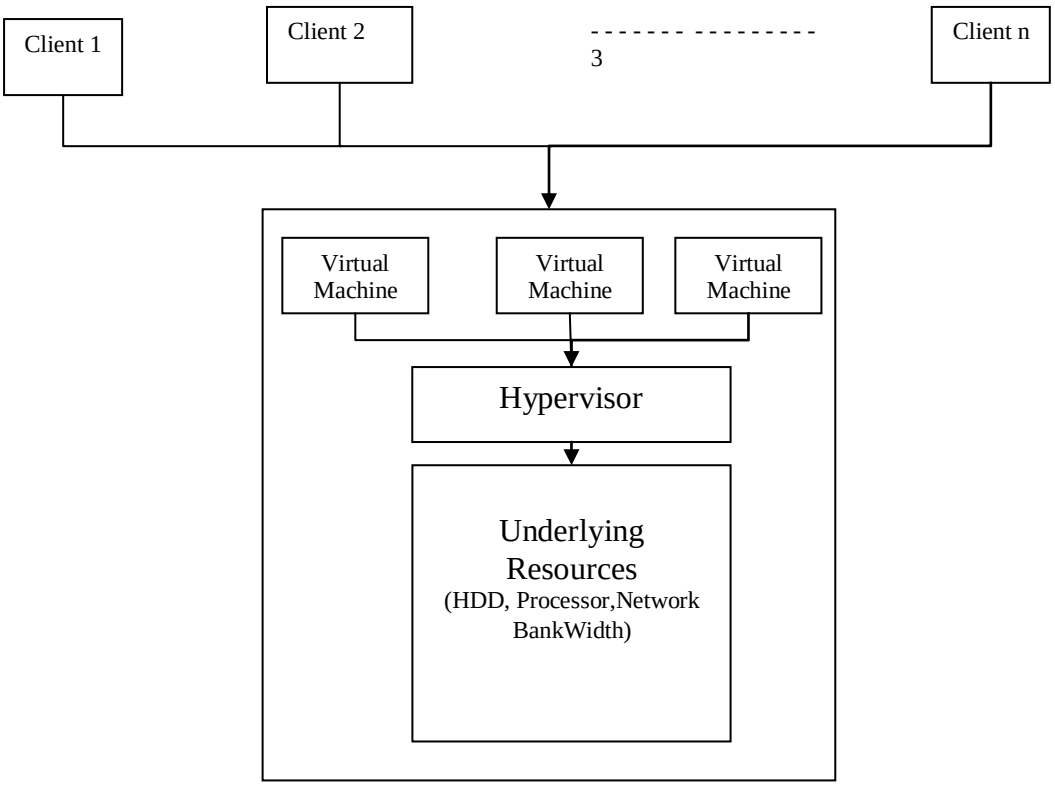

Fig 1.Technological framework

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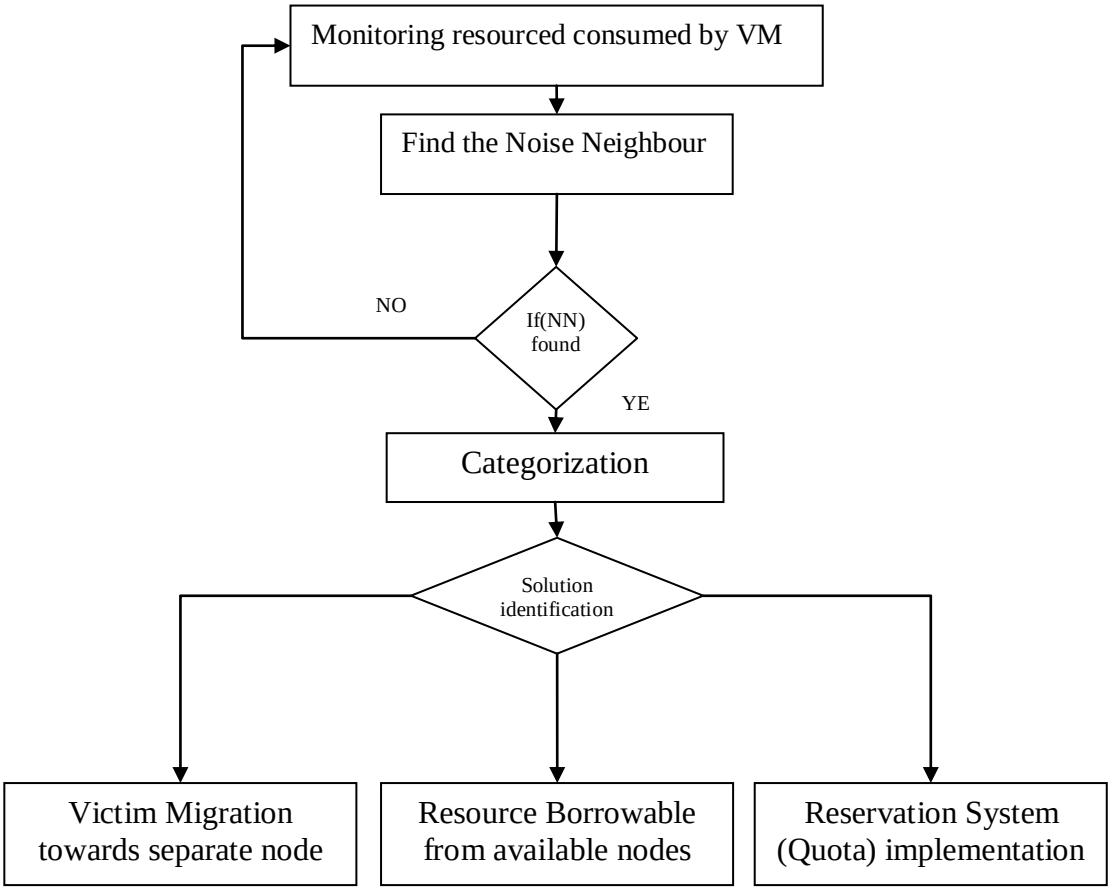

Fig 2.Solutions for handling noisy neighbour

Due to the scalable architecture of the cloud, the applications shared infrastructure is computationally non manageable at times. This condition prevail lead to the over utilization of shared infrastructure by the greedy application and they degrade the performance of the peer. These co-tenant are called as noisy neighbour and obviously the victim are those who are hunger for the resource which is under utilized and wait with delayed and un even infrastructure sharing. These issues have been addressed and a strategic method is proposed to deal with the noisy neighbour in the multi tenant cloud.

Based on our studies, three major solution is proposed to solve the noisy neighbour problem in the cloud infrastructure, one solution is solving the victim application, one is towards the greedy application and last solution is a common protocol in resource allocation. the presentation of the solutions are organized as follows, The section 5 presents the ways to identify noisy neighbours. The section 6 presents the ways to deal with the noisy neighbour. The sub section 6.1 presents the victim migration towards the separate node, the sub section 6.2 presents the method of borrowing of the available or over utilized resources and the sub section 6.3 presents the reservation quota scheduling in resource allocation. Section 7 presents the observations from the proposed solutions, section 6 presents the conclusion followed by the references

V. NOISY NEIGHBOUR IDENTIFICATION

To maintain the quality of service in the cloud infrastructure, the greedy application that over utilizes and act as a co tenant has to be identified at first. They are referred to as noisy neighbours. The classification of the categories of application and the continuous monitoring may lead to the identification of the Noisy Neighbour. The resource consumption of the application loaded on the Virtual Memory is been monitored based on the parameters like memory, network bandwidth consumption etc. Since the Virtual machines are on the hypervisor, As in demand the resource can be allotted and hence the hypervisor can allot CPU cycles it to the application. Due to the monitoring of the application, it can be noticed that the resource gets properly allotted to the requested application and not to the co tenant application. Hence the impact of the performance can be balanced. Based on the previous history of the resource utilization of the application, a classification can be done based on the availability, usability and the request of resources.

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VI. NOISY NEIGHBOUR HANDLING

The following are the ways to handle the noisy neighbours. Dealing the noisy neighbour in one of the following way may lead to the improvement of the performance and the quality of service of the system.

6.1. Victim Migration towards separate node

The applications starving for resources are called victim application. When a noisy neighbour is identified in the infrastructure, the applications imbalanced or lack with the available resources is shifted or moved to another node to minimize the overhead. This can be done as a combined effect of continuous monitoring of the application, the resource sharing and utilization.

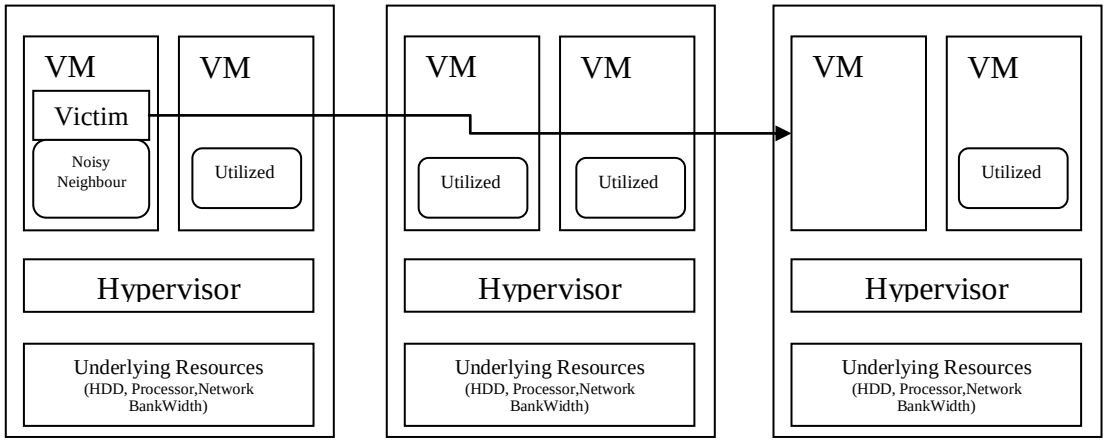

Fig 3 Victim Migration

The fig 3 illustrates the first solution for handling the noisy neighbour. During the performance degradation due to the availability of a noisy neighbour, the victim application is identified and migrated to another VM. This balances the performance and improves the Quality of Service.

There are many policies for migration from the actual node to a different node , but as a result, it improves the performance of the system in terms if efficiency in power, network utilization as balanced. The power efficiency can be handled by this method

6.2 Resource Borrowable from available nodes

The second method to deal with the noisy neighbour is to share the resources to the victim application from the other nodes. The application continue to run on the current node , this can be one of the methodology which suits to handle the noisy neighbour by additionally providing the resources underlying to the victim application.

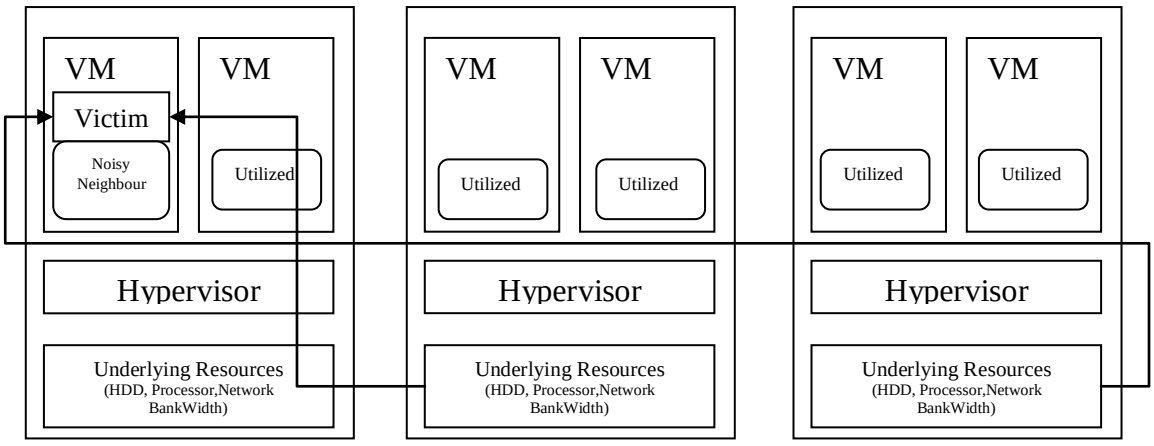

Fig 4: Resource Borrowing

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The fig 4 illustrates the resource borrowing infrastructure in cloud. This method seem to be an effective solution when there is a need not to migrate the application, hence the underlying resources can be given as shared utilization automatically without leaving a performance or quality of service degradation.

6.3. Reservation System (Quota) implementation

This is another methodology to solve the noisy neighbour problem, the resource are allocated to the application on demand and on reservation basis. Hence the over utilization can be completely avoided. Reservation quota will prevent the proper distribution of the resources by the application

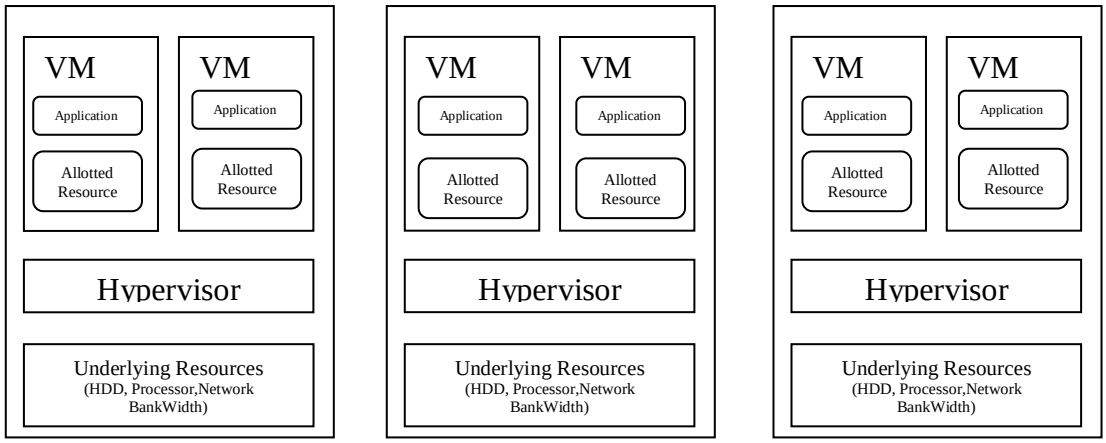

Fig 5 Reservation Resource allocation

The fig 5 represents the reservation based quota resource allocation to the applications. So there will be no need of migration and the borrowing in this category. The resource can be managed as the over utilization of the resource by any single co tenant or greedy application will be completely eradicated and this act as one of the optimum solution to handle noisy neighbour effect

VII. Observations from the proposed methods

The strategy to deal with a noisy neighbour cannot be limited to a single solution, hence in this paper we have provided multiple solutions for handling the same. The migration from the available node to a different node is commercially adopted and practised n pre copy and post copy VM automates live migration tool. The second solution of borrowing the underlying resource is commercially adopted by the services like cluster Vio-Clusters, SETI at home which partially adapt the traditional cycle stealing method. The methodology of the reservation quota is partially adapted in UEC in the enterprise cloud clusters. Hence its is observed that the combination of these solutions will be a proven effective and computationally worth . The outcome of the research will be the solution to the following ,

1. The methods which enable avoiding the noisy neighbour effects are presented
2. The effects of noisy neighbour is studied from the literature and the suitable frameworks are proposed to minimize the same
3. The research gaps in the existing methodologies are studied and the suitable solution frameworks are formulated.

VIII. Conclusion

In this research article, the solution to handle the noisy neighbour tenant in the multi tenant architecture of cloud infrastructure is studied. The identification of the noisy neighbour is done by the monitoring the application continuously and finding the difference or the additional requirement for the resource utilization by the similar applications. Handling the noisy neighbour is done by migration of the victim node, or the resource allocation on demand by borrowing and a systematic resource reservation methodology.

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