A Novel competitive analysis framework for auction of dynamic resource allocation in cloud

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***Abstract*— Usually clouds are created by admin, corresponds to virtual machine.VM resource is allocated through clouds then customers can access the resources from virtual machines. Customers make use of scaling methodologies in such a way that allocating more virtual machines to the customers which is said to be horizontal scaling and the resource which were owned by the customer is said to be vertical scaling. Although there are number of online auction mechanisms have been proposed to achieve dynamic cloud resource allocation and pricing, and treat dynamically-arrival customer demand as independent bids, ignoring possible connections among bids submitted at different times by a customer.**

In practical VM scaling, a customer may bid repeatedly after submitting his initial bid, to increase the resources needed, and hence later bids from the customer are relayed to earlier bids. Inorder to overcome problem of dynamic resource allocation and pricing with the demand of independent bids, a novel competitive analysis framework is proposed to perform the online auctioning to allocate the various resources available in the cloud network for multi tenant customers. This brings difficulty in online mechanism design to approximate the offline optimum, and calls for new solutions, which aims to achieve truthfulness, individual rationality, computational efficiency, and competitiveness in social welfare, i.e., a small ratio between the social welfare of online mechanism over that of the offline optimum, computed assuming full knowledge over the system spam. Designing efficient online mechanisms for a bi-directional market which is significantly more challenging, which investigate in the future work, possibly exploiting double auction.

***Keywords*— network resource allocation, virtual machine, multi resident cloud customer, online auction**

I. Introduction

With the rapid increase of usage of cloud computing, more and more individuals and businesses are resorting to cloud platforms for deploying services and running jobs. Besides purchasing, An accompanying important challenge, economics wise, is how to price the incremental resources on the go, such that the benefits of both the cloud provider and users are guaranteed. Usually clouds are created by admin, corresponds to virtual machine.VM resource is allocated through clouds then customers can access the resources from virtual machines. Customers make use of scaling methodologies in such a way that allocating more virtual machines to the customers which is said to be horizontal scaling and the resource which were owned by the customer is said to be vertical scaling. Almost all the current IaaS offerings adopt fixed pricing, to charge a fixed unit price per preconfigured VM or per unit of resources, which does not change in the short term. There have been recent practices and proposals towards market-based pricing, for timely adaptation to demand-supply relation changes that allocates resources to users who value the resources most and boosts both provider revenue and user utility. The Spot Instance market of Amazon EC2 is the pioneer production system adopting bidding-based dynamic VM pricing, but has been shown by studies not being a truly market-driven pricing system.

A number of online auction mechanisms have been proposed to achieve dynamic cloud resource allocation and pricing. They treat dynamically-arrival user demands as independent bids, ignoring possible connections among bids submitted at different times by a user. The cloud provider packs the demanded VMs on heterogeneous servers for energy cost minimization on the go. Inorder to overcome problem of dynamic resource allocation and pricing with the demand of independent bids, a novel competitive analysis framework is proposed to perform the online auctioning to allocate the various resources available in the cloud network for multi tenant customers. This carefully design resource prices maintained for each type of resource on each server to achieve threshold-based online allocation and charging, as well as a novel competitive analysis technique based on sub modularity of the offline objective, to show a good competitive ratio is achieved. The rest of the paper is as follows: Section II presents the related work, Section III presents the Proposed work. The section IV discusses about the System modules of the work, Section V presents the design of the work, section VI discusses about the implementation of the proposed work and respective test cases and Section VII concludes the work.

II. Related Work

Cloud computing is emerging as a promising field offering a variety of computing services to end users. These services are offered at different prices using various pricing schemes and techniques. End users will favor the service provider offering the best QoS with the lowest price. Therefore, applying a fair pricing model will attract more customers and achieve higher revenues for service providers[1]. This work focuses on comparing many employed and proposed pricing models techniques and highlights the pros and cons of each. The comparison is based on many aspects such as fairness, pricing approach, and utilization period. Such an approach provides a solid ground for designing better models in the future. It has founded that most approaches are theoretical and not implemented in the real market, although their simulation results are very promising. Moreover, most of these approaches are biased toward the service provider[2].

The rapid deployment of cloud computing promises network users with elastic, abundant, and on-demand cloud services[3]. The pay-as-you-go model allows users to be charged only for services they use. Current purchasing designs, however, are still primitive with significant constraints. Spot Instance, the first deployed auction-style pricing model of Amazon EC2, fails to enforce fair competition among users in facing of resource scarcity and may thus lead to untruthful bidding and unfair resource allocation. Dishonest users are able to abuse the system and obtain (at least) short-term advantages by deliberately setting large maximum price bids while being charged only at lower Spot Prices. Meanwhile, this may also prevent the demands of honest users from being satisfied due to resource scarcity. Furthermore, Spot Instance is inefficient and may not adequately meet users' overall demands because it limits users to bid for each computing instance individually instead of multiple different instances at a time. The proposed work presents the formulate and investigate the problem of cloud resource pricing. The proposed work includes a suite of computationally efficient and truthful auction-style pricing mechanisms, which enable users to fairly compete for resources and cloud providers to increase their overall revenue. Analytically it is showed that the proposed algorithms can achieve truthfulness without collusion or (t, p)-truthfulness tolerating a collusion group of size t with probability at least p. It also show that the two proposed algorithms have polynomial complexities O(nm + n2) and O(nm), respectively, when n users compete for m different computing instances with multiple units. Extensive simulations show that, in a competitive cloud resource market, the proposed mechanisms can increase the revenue of cloud providers, especially when allocating relatively limited computing resources to a potentially large number of cloud users.

Auction design has recently been studied for dynamic resource bundling and virtual machine (VM) provisioning in IaaS clouds, but is mostly restricted to one-shot or offline setting[4]. This paper targets a more realistic case of online VM auction design, where: 1) cloud users bid for resources into the future to assemble customized VMs with desired occupation durations, possibly located in different data centers; 2) the cloud provider dynamically packs multiple types of resources on heterogeneous physical machines (servers) into the requested VMs; 3) the operational costs of servers are considered in resource allocation; and 4) both social welfare and the cloud provider's net profit are to be maximized over the system running span. The design includes the truthful, polynomial time auctions to achieve social welfare maximization and/or the provider's profit maximization with good competitive ratios. Our mechanisms consist of two main modules:

An online primal-dual optimization framework for VM allocation to maximize the social welfare with server costs, and for revealing the payments through the dual variables to guarantee truthfulness [5].

1) A randomized reduction algorithm to convert the social welfare maximizing auctions to ones that provide a maximal expected profit for the provider, with competitive ratios comparable to those for social welfare. It adopts a new application of Fenchel duality in our primal-dual framework, which provides richer structures for convex programs than the commonly used Lagrangian duality, and our optimization framework is general and expressive enough to handle various convex server cost functions. The efficacy of the online auctions is validated through careful theoretical analysis and trace-driven simulation studies[6].
2) This study presents an online combinatorial auctions with production costs proposed by Blum et al. using the online primal dual framework. In this model, buyers arrive online, and the seller can produce multiple copies of each item subject to a non-decreasing marginal cost per copy. The goal is to allocate items to maximize social welfare less total production cost. For arbitrary (strictly convex and differentiable) production cost functions, it characterize the optimal competitive ratio achievable by online mechanisms/algorithms. It is showed that online posted pricing mechanisms, which are incentive compatible, can achieve competitive ratios arbitrarily close to the optimal, and construct lower bound instances on which no online algorithms, not necessarily incentive compatible, can do better. The positive results improve or match the results in several previous work, [7,8]. The lower bounds apply to randomized algorithms and resolve an open problem by Buchbinder and Gonen.
3) Elastic resource scaling lets cloud systems meet application service level objectives (SLOs) with minimum resource provisioning costs [9]. In this work, it presents Cloud Scale, a system that automates fine grained elastic resource scaling for multi-tenant cloud computing infrastructures. Cloud Scale employs online resource demand prediction and prediction error handling to achieve adaptive resource allocation without assuming any prior knowledge about the applications running inside the cloud. Cloud Scale can resolve scaling conflicts between applications using migration, and integrates dynamic CPU voltage/frequency scaling to achieve energy savings with minimal effect on application SLOs. This work presents the implementation of Cloud Scale on top of Xen and conducted extensive experiments using a set of CPU and memory intensive applications (RUBiS, Hadoop, IBM System S). The results show that Cloud Scale can achieve significantly higher SLO conformance than other alternatives with low resource and energy cost. Cloud Scale is non- intrusive and light-weight, and imposes negligible overhead (< 2% CPU in Domain 0) to the virtualized computing cluster[10].

A number of online auction mechanisms have been proposed to achieve dynamic cloud resource allocation and pricing. They treat dynamically-arrival user demands as independent bids, ignoring possible connections among bids submitted at different times by a user.

A. *Disadvantages of Existing Work*

- The resource increase cannot exceed the physical limit of a physical server
- Scale-out may involve data replication and be thus costly.

III. PROPOSED WORK

Targeting market-driven, dynamic resource provisioning and pricing for VM scaling, this proposes a provenly efficient online auction mechanism. The proposed work presents the novel competitive analysis framework for online auction design aims to achieve truthfulness, individual rationality, computational efficiency, and competitiveness in social welfare, i.e., a small ratio between the social welfare of the online mechanism over that of the offline optimum, computed assuming full knowledge over the system span. The proposed work includes an expressive bidding language to characterize different cases of dynamic demand scaling, which allows users to request and scale resources on different servers according to their preferences. It also uncovers the underlying relation between users online bidding behavior and the offline social welfare maximization problem. The proposed work identifies an important property of the offline social welfare function namely sub modularity, which plays a crucial role in our analysis.

A) Novel Competetive Analysis Framework

A novel competitive analysis framework is proposed which includes the following methodology to overcome the drawbacks presented in this section. The following are the steps:

1. An online auction design aims to achieve truthfulness, individual rationality, computational efficiency, and competitiveness in social welfare.
2. Allowing of users requests to scale resources (space) on different servers as per their preferences.
3. An important property of the offline social welfare function namely sub modularity.

A. *Advantages of Proposed Work:*

- Truthful and efficient online auction for dynamic resource scaling and pricing.

IV. SYSTEM MODULES

1. User Interface Design
2. Admin
3. Cloud
4. Virtual Machine
5. User

A) User Interface Design:

In this module, the design of the windows. These windows are used for secure login for all users. To connect with server user must give their username and password then only they can able to connect the server. If the user already exits directly can login into the server else user must register their details such as username, password and Email id, into the server. Server will create the account for the entire user to maintain upload and download rate. Name will be set as user id. Logging in is usually used to enter a specific page.

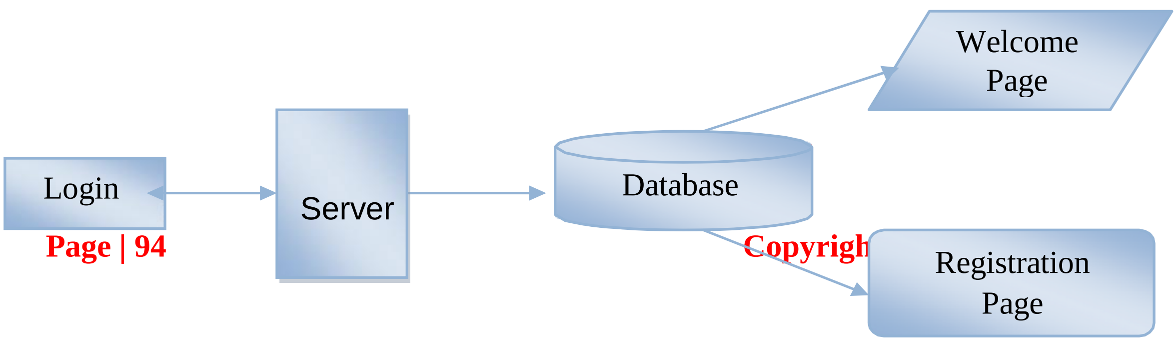

Figure 1: User Interface Design

B) Admin:

This is the first module of this work. In this module initially admin need to login. Then admin will create the cloud with some space. And he will manage the cloud details like how many VM instances create to a cloud and how many resources that are providing by the cloud. And admin will manage the VM scaling details. That means how many users are available and how they are utilizing the VM.

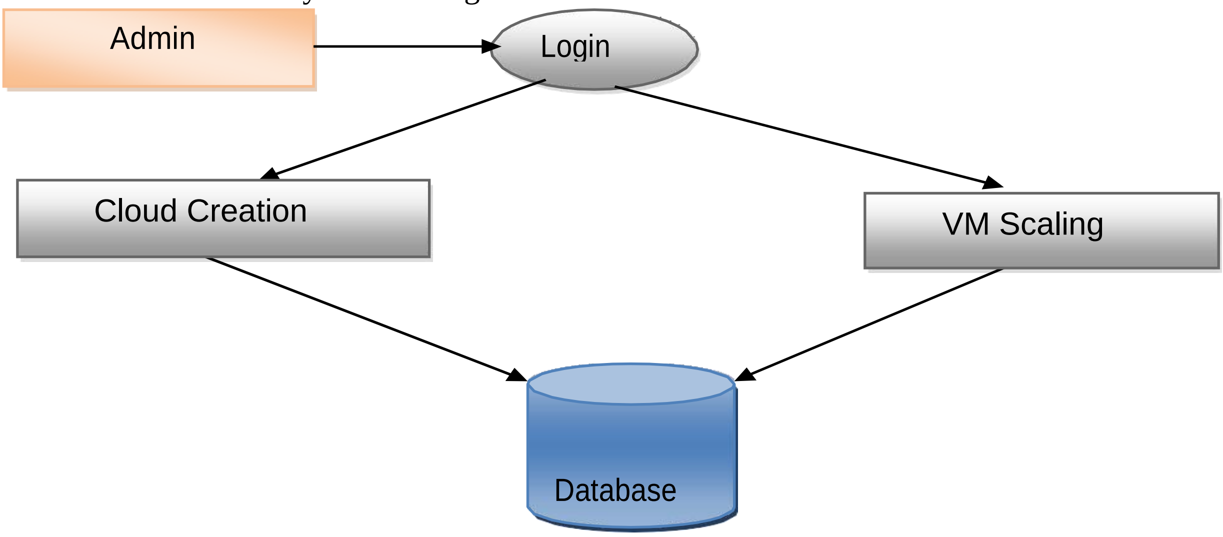

Figure 2: Admin

This is the second module of this work. In this module initially cloud owner need to login. Then he will verify the VM requests to allocate the space and resources.

3) Cloud:

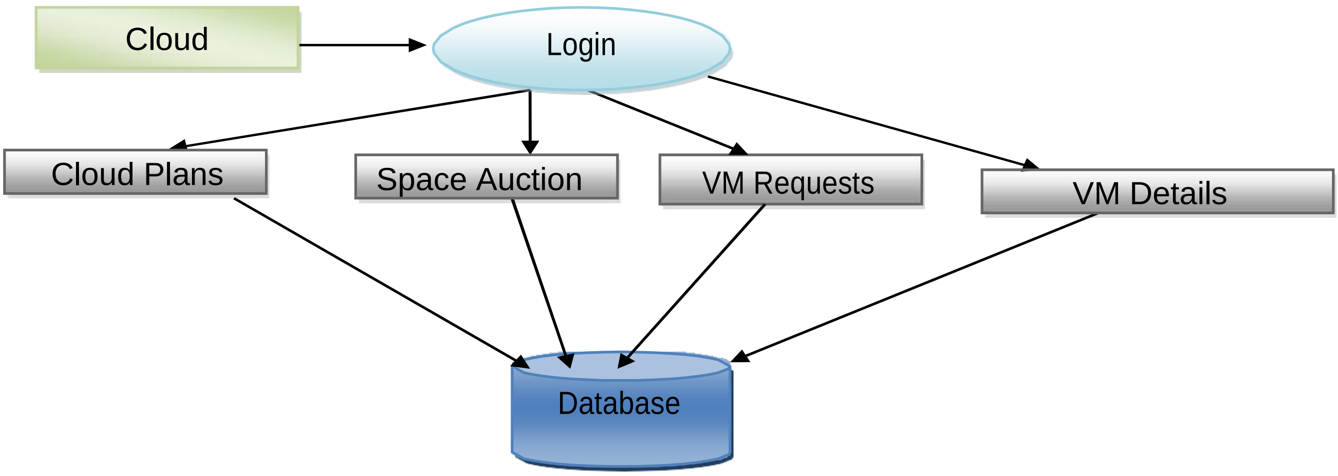

Figure 3: Cloud

If any VM user wants upgrade their plans that will approval. And online auction for increasing the space of VM between different users and then who will pay more amounts then space will allocate those VM users. And VM can be removed if the expiry date completed to utilize the space in that particular cloud.

4) Virtual Machine

This is the third module of this work. In this module initially VM owner need to login. Then he will verify the request of resource from different users while they are registering. If he approved then user can utilize the space by paying the money based on his utilization. If the space or expiry date of VM occurs it need to reclaim his space by online auction. And any user bills need to maintain. And resource up gradation needs to maintain.

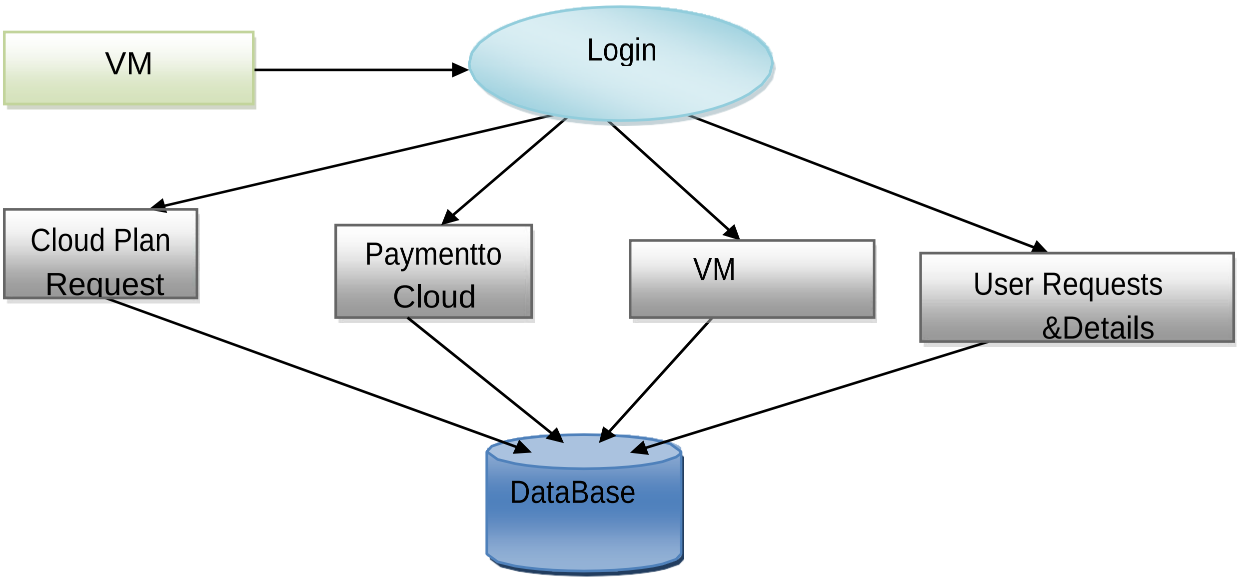

Figure 4: Virtual Machine

5) User:

This is the fourth module in this work. In this module initially user need to login. Then user can share store the data based on the size. Depending the resource user need to pay the amount to the VM Owner. If user wants to upgrade his resource he can upgrade by paying required amount. If user wants change the VM resource he can use other VM which will provide better resources.

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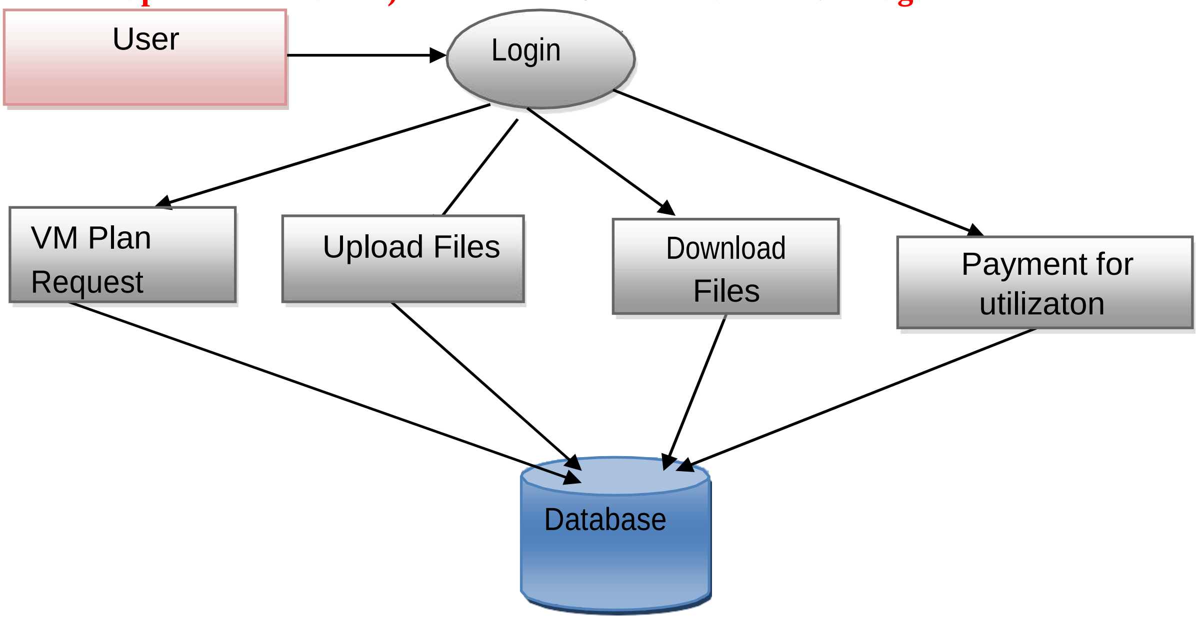

Figure 5: User

V. DESIGN

The design of the proposed system includes the various listed UML diagrams such as Use Case diagram, Class diagram and Sequence diagram. Respective UML diagrams are designated and their represented is presented in this section.

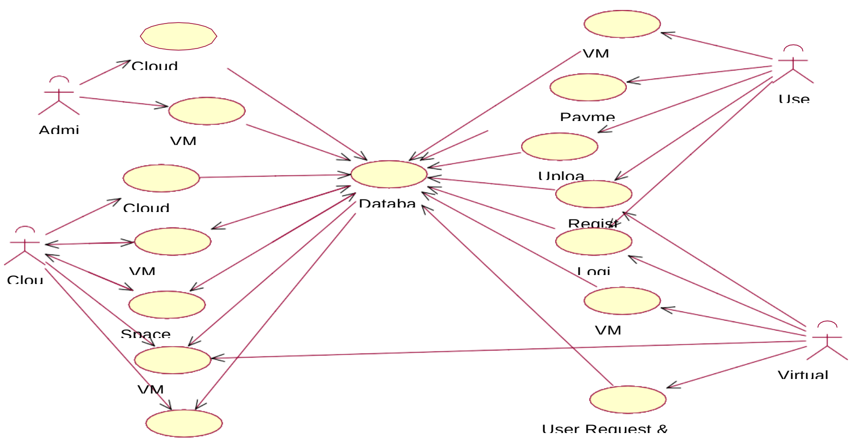

Figure 6: Use Case Diagram of Online Auctioning

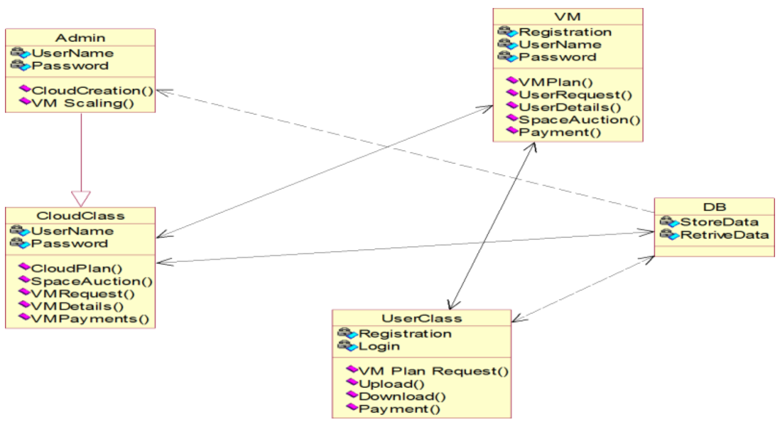

Figure 7: Class Diagram of Online Auction

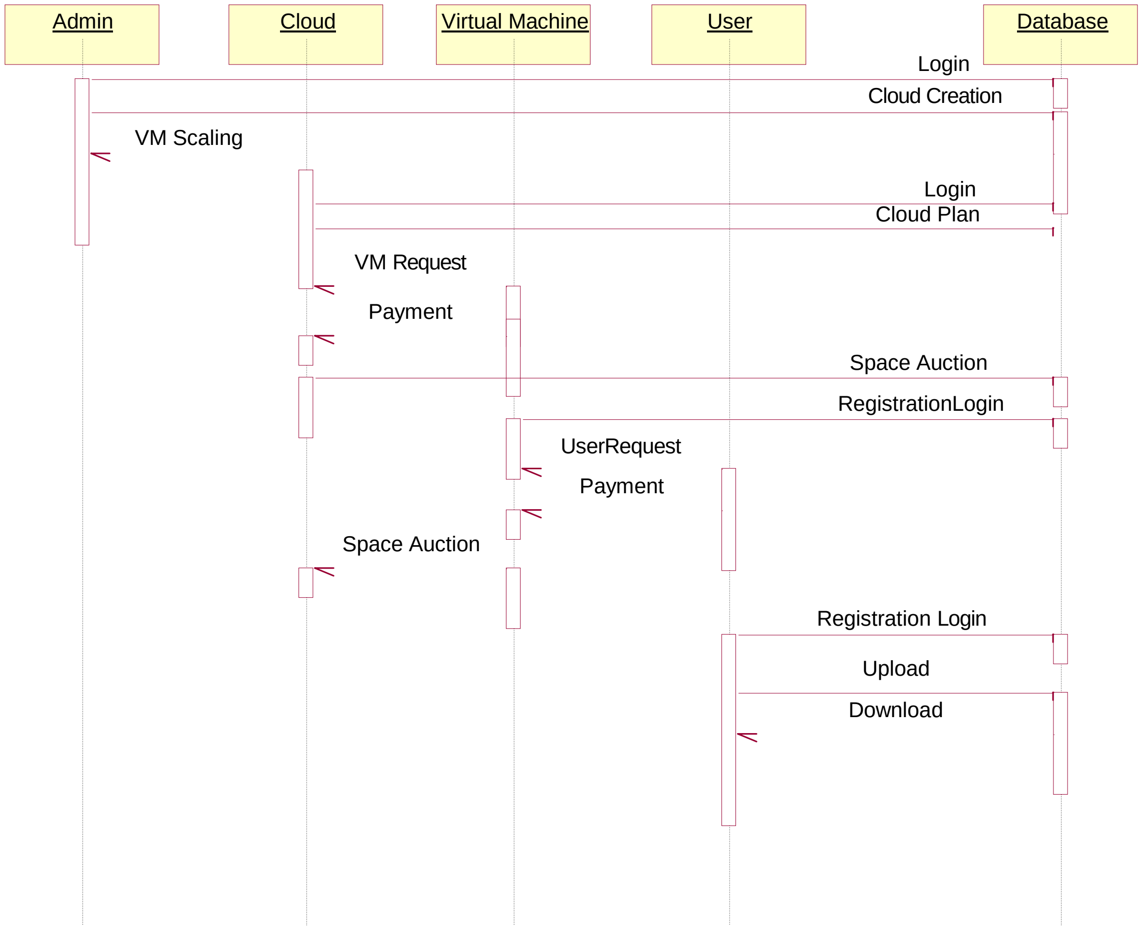

Figure 8: Sequence Diagram Online Auctioning

VI. IMPLEMENTATION

The proposed work is implemented using the various software tools for the execution of its various results. The IDE used for the development of system is Eclipse IDE, JSPs are used to design the front-end design. MYSQL5.5 version is used as the database purpose.Various snapshots of the novel competitive analysis framework for online auction of resources for multitenant cloud customers are as follows:

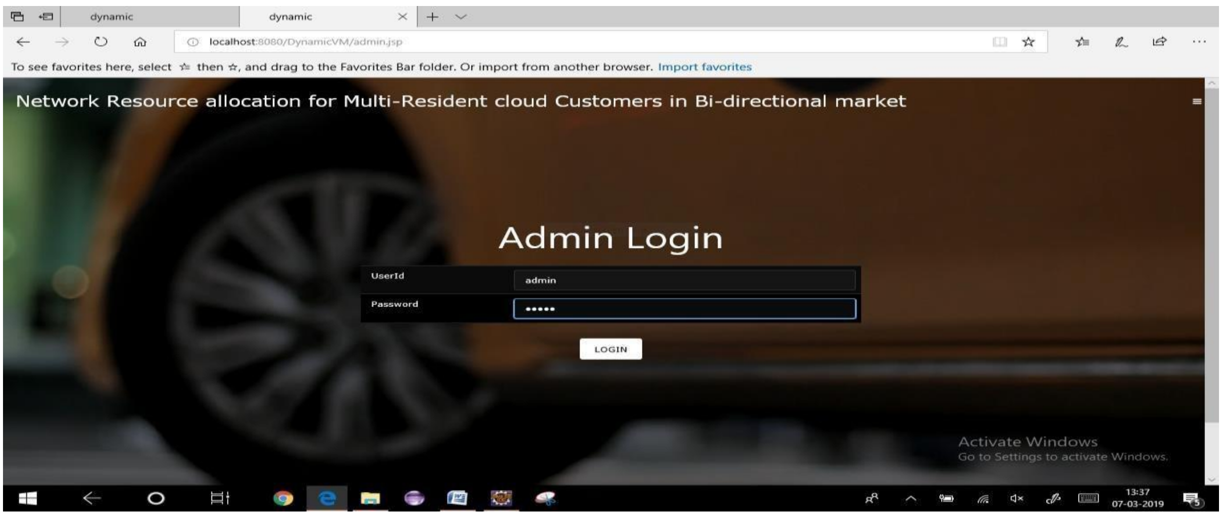

Figure 9: Admin Login

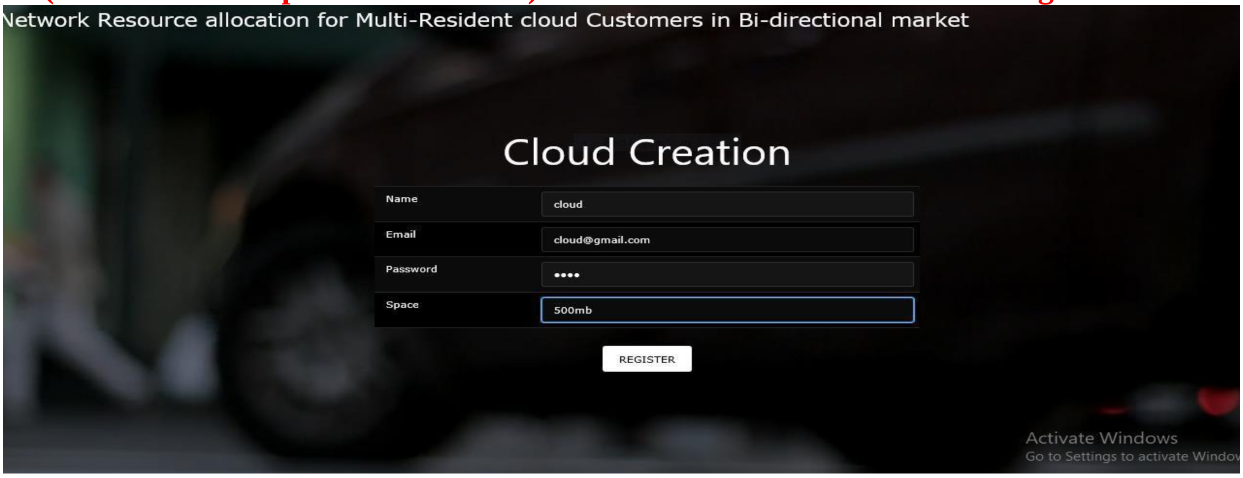

Figure 10: Cloud Creation

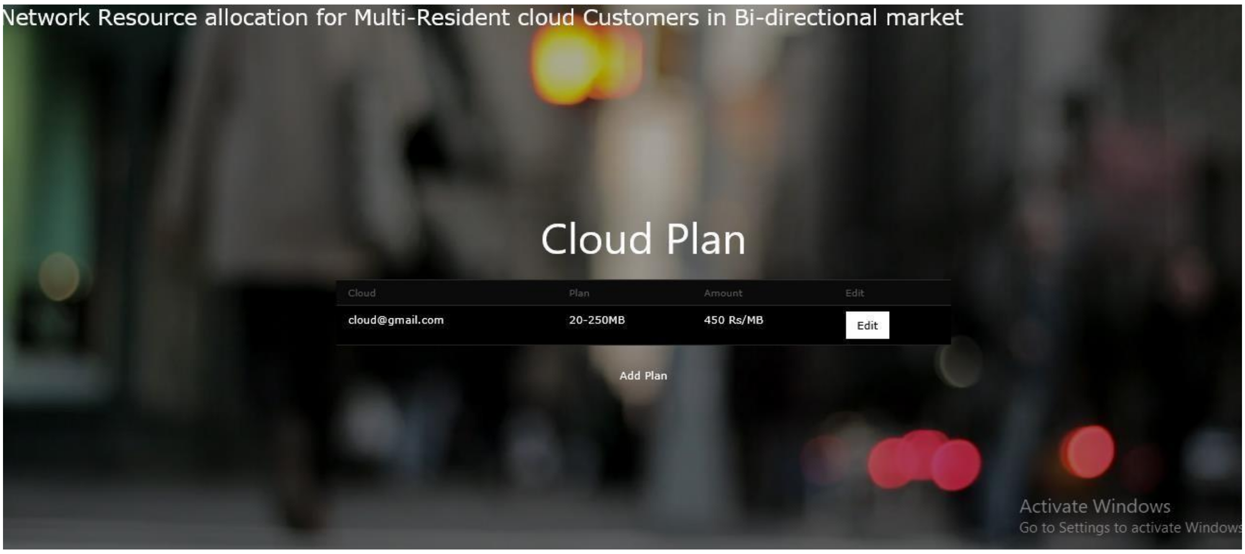

Figure 11: Cloud Plan

Figure 12: Available Cloud Plans

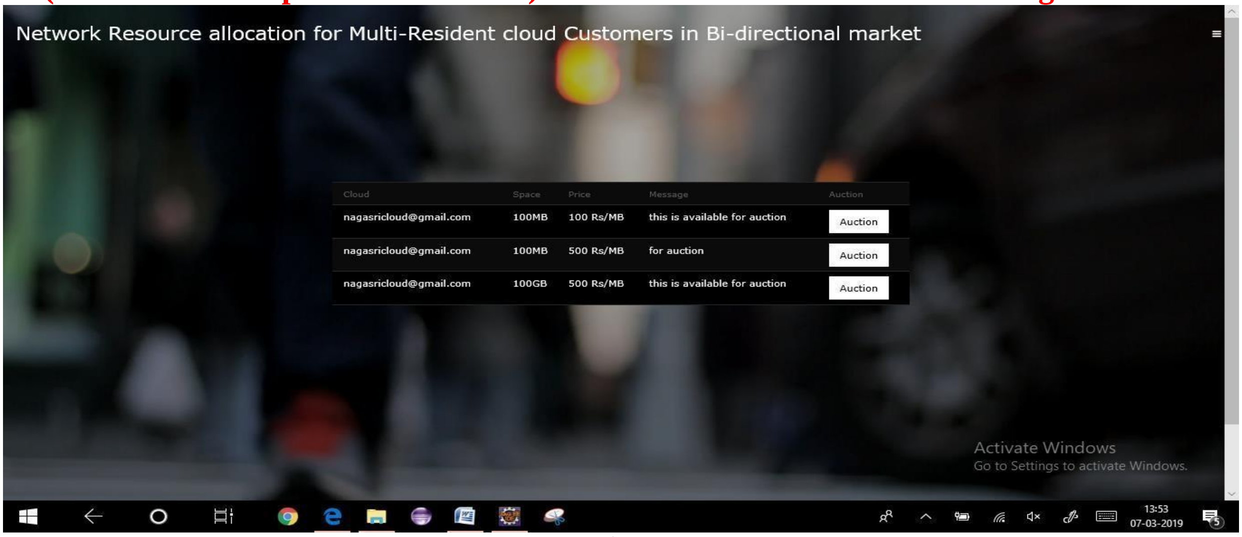

Figure 13: List of available auctions

The Figure 13 presents the online auction system which allows the various users to perform the online auctioning process. Each user may choose the respective online auction and allocate the respective auction. Using this process, the multiple resident cloud customers may choose from the various network resources. The space may be created and cloud plans can be also created. Using this system, the online auctioning process may be conducted.

The server energy cost minimization is considered for the social welfare maximization. This proposed work solves the network resource allocation for multi resident cloud customers to access the various resources available to access. The proposed work presents the online auction design aims to achieve truthfulness, individual rationality, computational efficiency, and competitiveness in social welfare, i.e., a small ratio between the social welfare of the online mechanism over that of the offline optimum, computed assuming full knowledge over the system span. The proposed work includes an expressive bidding language to characterize different cases of dynamic demand scaling, which allows users to request and scale resources on different servers according to their preferences. It also uncovers the underlying relation between users online bidding behavior and the offline social welfare maximization problem.

The cloud provider packs the demanded VMs on heterogeneous servers for energy cost minimization on the go. This carefully design resource prices maintained for each type of resource on each server to achieve threshold-based online allocation and charging, as well as a novel competitive analysis technique based on sub modularity of the offline objective, to show a good competitive ratio is achieved. This work considers the server energy cost minimization in social welfare maximization, and reveal an important property, sub modularity, of the objective function in the resulting significantly more challenging offline problem.

A) Various Test cases:

Test Case no	Input	Expected Behavior	Result	Test case Result

1	Registration Form	Registered Successfully	open home page	Pass
2	Registration Form	Registered Un Successfully	Invalid credentials redirected to registration form	Fail
3	Admin login	Open admin page	Welcome to admin	Pass
4	Admin login	Unable to Open admin page	Invalid username and password redirected to admin login page	Fail
5	Cloud login	Open cloud login page	Welcome to cloud	Pass
6	Cloud login	Unable to Open cloud login page	Invalid username and password redirected to cloud login page	Fail
7	Virtual Machine login	Open Virtual Machine	Welcome to Virtual Machine	Pass

8	Virtual Machine login	Unable to Open Virtual Machine	Invalid username and password redirected to VM login page	Fail
9	User login	Open User page	Welcome to cloud	Pass
10	User login	Unable to Open User page	Invalid username and password redirected to user login page.	Fail

Table 1: Test Cases of Online Auction Report

VII. Conclusions

The proposed work designs a truthful and efficient online auction for dynamic resource scaling and pricing, where cloud users repeatedly bid for resources into the future with increased amounts, according to their scale-up/out preferences. A Novel competitive analysis framework is proposed to perform the online auctioning to allocate the various resources available in the cloud network for multi tenant customers. The proposed work considers the server energy cost minimization in social welfare maximization, and reveal an important property, sub modularity, of the objective function in the resulting significantly more challenging offline problem. The proposed work focuses on dynamic increase of resources, which is supported in today's IaaS clouds. On the other hand, resource scale-down and scale-in involve selling resources back to the provider. Designing efficient online mechanisms for a bi- directional market is significantly more challenging, which it seeks to investigate in future work, possibly exploiting double auctions.

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