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Development of Optimized Resource Provisioning On-Demand Security Architecture for Secured Storage Services in Cloud Computing

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Abstract—* Cloud Computing makes it possible for providers to quickly deploy and scale services and obtain benefit from pay-by-use models under low cost, while users enjoy the flexibility of Internet-based computing services. Users find it difficult to fully trust cloud-based services because cloud-based data storage and protection methods are largely user transparent. In the early stages of cloud security there is no universal model or set of techniques has yet emerged. It includes method of segregating user resources during data processing. It is also necessary to optimize the resource cost. With the reservation plan, the consumer can reduce the total resource provisioning cost. Along with security resource provisioning is also play a vital role. In the on-demand security architecture, where it differentiates security according to service-specific characteristics avoids an unnecessary drain on IT resources by protecting a variety of computing resources just at right level. This is the best mechanism to provide required security level to all the Data Centers. From our literature survey, it is observed that the existing system fails to provide right security for all the Data Centers. i.e. this system doesn't provide correct security to Data Centers. In the existing on-demand security architecture the optimized resource provisioning mechanism is not there. So, we are planning to provide this facility along with security mechanism. To reduce resource provisioning cost this work focuses an optimal cloud resource provisioning (OCRP) algorithm can be used to improve the resource provisioning along with security mechanisms.

Index Terms — **On-Demand Security Architecture, Resource Provisioning.**

I. INTRODUCTION

In cloud computing, massive amount of computing resources are distributed over the virtual datacenters which can be accessed as service via user interfaces such as web browser. The pool of computing resources made available to the users as per their requirement through the internet. Computing resources such as power for processing, storage, and software and network bandwidth are allocated to cloud users to execute their tasks. Infrastructure-as-a-Service (IaaS) is one of the computational service utilized in cloud environment. For Iaas environment, user need virtualization technologies to access the cloud resources. Cloud consumer package the software stack (operating system and applications) with virtual machines (VMs). The hardware requirement of VMs also configured by the cloud consumers. The computing resources stored at cloud provider are outsourced by VMs to execute jobs at consumer side. The main objective of resource provisioning mechanism is to supply cloud consumers a set of computing resources for processing the jobs and storing the data [2]. Cloud service provider (CSP) can offer two basic resource provisioning plans namely short term on-demand and long term reservation plans. On demand plan is charged as pay-per-use basis, pay the money for resource and get resources as per the customer requirement. Short term reservation plan is about 1 year and the long term plan is about 3 years. In the reservation plan the resource cost paid as a one time payment (for 1 year) and this reserved resource will be utilized by the consumer [2]. By comparing this two plans cost wise, the consumer can utilize the resource under low cost by reservation plan compared to the on demand plan. By this way consumer can reduce the cost of resource provisioning with the help of reservation plan. In the reservation plan, under provisioning problem can occur when the reserved resources are unable to meet the actual demand. This under provisioning problem can be solved by provisioning more resources by on-demand plan to fit the extra demand, even though the price of on demand plan is higher than the reservation plan. The over provisioning problem can occur if the reserved resources are more than the actual demand requirement. It is necessary to minimize the total provisioning cost by reducing the on-demand cost and oversubscribed cost of under provisioning and over provisioning. To attain this goal we need to optimize the resource provisioning cost for that we focus on Optimal Resource Provisioning Algorithm (OCRP) to achieve this objective. This algorithm minimizes the provisioning cost of the resources within certain time period.

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II. RELATED WORK

Reserved instance purchased through the 1 or 3 year plan, in this case one-time fee per instance will not be refundable. In on-demand instances doesn't having long-term commitments and it is free from complexities of planning, purchasing in advance. On-demand instances are said to be spot instance which is relatively high cost to utilize those instances [7]. The main advantage of the spot instances is to accelerate the runtime of applications which are utilizing spot instances. It optimizes the tasks, improves the performance and these instances nice-to-have but not strictly required. Eucalyptus, Hadoop and Open Nebula are open cloud frameworks where the service manager handles all user requests and provide billing. User will request resources VM will transfer those requests to data broker. The broker will interact with service manager and provisioning the resources [8]. Amazon EC2 provides Infrastructure-as-a-service (Iaas) and offer the resource based on user demand [13]. Open source cloud technology will increase resource utilization and reduce provisioning cost [18]. It consists of some common resources in open cloud environment. We may use this technology in many organizations to execute their own applications. This will improve the cost of resource provisioning performance in cloud environment.

III. EXISTING SYSTEM

Cloud services involve public information that requires only basic security. Other applications such as banking transactions, involve more sensitive information. Client-server systems tend to use the strongest security solution which protects all network services, but such an approach is not effective for cloud computing, it wastes resources and makes service usage unnecessarily complex. So, a security-on-demand design is an optimal solution to this problem. This architecture design applies security algorithms and protocols according to three stages in the service data's life cycle: in transmission, in process, or in storage.

A. Input layer

The three inputs into the input layer determine which security policy will govern the service.

Security level: The service provider's system must allow the authorized user's simultaneous access based on the security clearance and authorization level and CSP disallows the unauthorized users. Security level tasks should satisfy the system requirements. Each cloud service provider offers a minimum service security level, which means that users cannot able to choose or to set a security level but still it receive minimum protection.

Service type: This architecture includes service type in the input layer because different service types needed for different security mechanisms. For example, a multi-media service, is sensitive to time delay, allows a certain degree of packet loss, and does not require integrity verification. For a file transmission service, in contrast, integrity verification is an essential protection mechanism. Users need not specify service type of particular service. Once a user starts perform a specific service, the cloud service automatically configures the service type input.

Access network risk : The risk of attack while the service passes through the access network—such as 3G, public Wi-Fi, or wired office networks—depends on the network being used. The risk is relatively high with a public Wi-Fi access network and relatively low with a wired intranet.

Users need not specify the access network risk. The cloud service can acquire that value from the terminal location, the IP address range at the user's terminal, or border entities at the access network. Normally, the higher the risk, the stronger the security mechanisms must be.

B. Policy layer

In the policy layer, three security policies receive inputs simultaneous and it produces the security mechanism parameters on the input parameter based on the specified security level, service type, and access network risk. These three inputs decide the strength and combination of security mechanisms, the security policy's major responsibility is to evaluate those inputs and make the appropriate security parameter mix. These parameters, in order, ensure that security mechanisms protect the service at a consistent security level based on their domain. Each security policy produces the parameter mix that will activate security mechanisms in one of the three domains. In the network security domain, for example, IPSec is an important security mechanism. The Security Association (SA) handles many of IPSec's security parameters, such as protocol type, package mode, encryption algorithm, and key life cycle.

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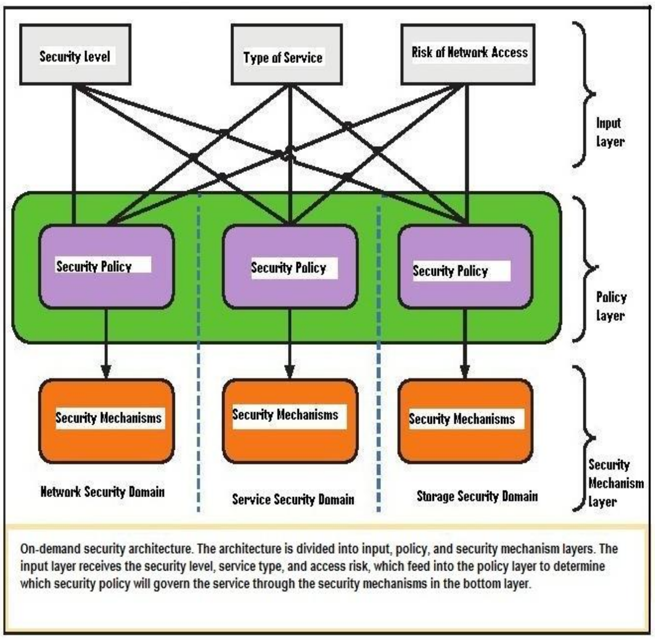

Fig. 1 On demand Security Architecture

C. Security Mechanism Layer

Each domain is controlled and handled by a particular security policy, which in turn provides the appropriate security mechanisms, such as IPsec in the network security domain, honeypot in service security domain, and data encryption/decryption in the storage security domain. Some security mechanisms are suitable for more than one security domain, depending on their function. For example, intrusion detection is network-based in the network security domain, but it becomes host-based in the service security domain. A security-on-demand design over cloud as an existing system. In that architecture resource provisioning optimization feature will not be there so include that feature and build an optimized resource provisioning on demand security architecture. This resource provisioning optimization is done through the stochastic integer programming method. This algorithm achieved through Stochastic integer programming, deterministic equivalent formulation.

IV. PROPOSED SYSTEM

In this system with the help of reservation plan, the cloud consumers can reserve the resources in advance based on their need. When the reserved resource in capable to satisfy the demand due to uncertainty, in that situation under provisioning problem will occur. This problem can be solved by provisioning more resources based on on-demand plan. Here by, provisioning resources will have expensive cost while provisioning in on demand basis. Alternatively, the over provisioning problem can occur if the reserved resource will be more than the actual demand. In this situation the resources available in the resource pool get underutilized.

It is essential for the cloud consumer to minimize the total cost of resource provisioning by reducing the on-demand cost and oversubscribed cost of under provisioning and over provisioning problem. An OCRP (optimal cloud resource provisioning) algorithm is to minimize the total cost for resource provisioning. This algorithm consists of multiple provisioning stages with uncertainty parameters demand and price. To get an optimal result, the demand uncertainty from cloud consumer side and price uncertainty from cloud provider side are taken into account for consideration between on-demand and oversubscribed costs. This OCRP algorithm can be solved by stochastic integer programming and deterministic equivalent formulation.

The proposed system consists of four components. The core components are cloud consumer, cloud broker, cloud provider and virtual machine (VM) repository. The computing resources are stored and maintained by cloud service provider. Initially cloud consumer has demand to execute a job. For the particular job execution consumer is in need of resources, so consumer can request the resources to cloud provider. To perform resource provisioning and to obtain resources, consumer creates VMs integrated with software. The created VMs are stored in VM repository. The VMs created by consumer are hosted on cloud provider’s infrastructure. These VMs are responsible for provisioning required resources from provider. Cloud broker act as intermediary between cloud consumer and provider. The broker can allocate the VMs from the VM repository to appropriate

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consumers. Cloud broker implements the OCRP algorithm to make an optimal decision of resource provisioning. A cloud provider can suggest the consumer two provisioning plans, i.e., reservation and on-demand plans. In planning, the reservation plan is considers as short and long-term plan. Short term reservation plan is about 1 year and the long term resource plan is about 3 years. The on demand plan is consider as short term planning.

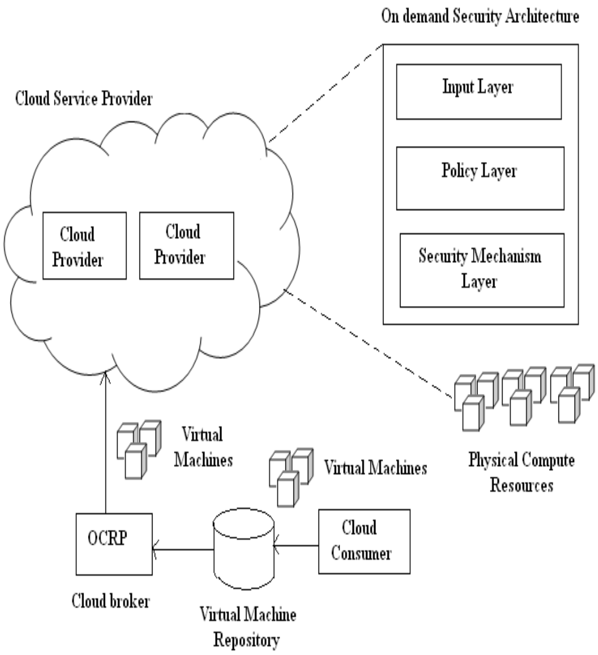

Fig. 2 Optimized resource provisioning on demand Security Architecture

A. Resource Provisioning Plans

The cloud service provider can offer two resource provisioning plans specifically reservation and on-demand plans. In this planning scheme, cloud broker considers the reservation plan as medium to long term planning about 1 to 3 years in which the resources are reserved in advance. The cloud broker considers the on-demand plan as a short term planning, where we can get resources through this plan while the insufficient of the resources may found to execute a particular job.

B. Resource Provisioning Phases

Provisioning resources can be done by reservation and on-demand plans. The resources provided by such plans are used in different time intervals, also known as provisioning phases. The three main provisioning phases are reservation, expending and on-demand phases.

Reservation Phase: In this phase, the consumer is in need of resources to execute their jobs. For that the consumer can reserve the resources in prior through the reservation provisioning plan. The reservation of the resources may reduce the cost of provisioning than the on-demand provisioning. The overprovisioning problem can occur if the reserved resources are more than the actual demand requirement.

Expending Phase: This expending phase provide the details about the cost of resources acquired by the consumer. The uncertainty parameters such as price and demand can be realized in this phase only. Cloud provider furnishes the price details to the consumer regarding resource provisioning.

On-demand Phase: In the reservation phase, without aware of the consumer’s actual demand, the cloud broker provisions resources in the reservation plan in advance. After the execution of the particular job the consumer may in need of additional resources and request it to cloud provider [2]. Normally, the on-demand cost is higher than the reserved resource cost.

C. Resource Provisioning Stages

Provisioning phase is divided into number of provisioning stages considered by the cloud broker, e.g., one year plan consists of 12 provisioning stages (i.e., 12 months). For resource provisioning under uncertainty parameters, initially the broker reserves the resources in the first provisioning stage. In each and every stage resource reservation as well as usage is observed by the broker. The observed uncertainty parameters (price, demand) are called realization. For that the broker will take course of action (known as recourse action) according to the realization, i.e., utilizing the resources which provisioned based on reservation and on-demand

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plans. In realization it performs the action of realizing how much resources utilized, the price and demand is observed in the realization.

D. Transition of Provisioning Phases

The consumer will reserve the resources based on the reservation constraints, time with help of their reservation id [6]. For example, Amazon EC2 provider has two reservation plans. i.e., Reservation and On-demand plan. Reservation contracts based on 1 year and 3 year plan based on the requirement of the consumer.

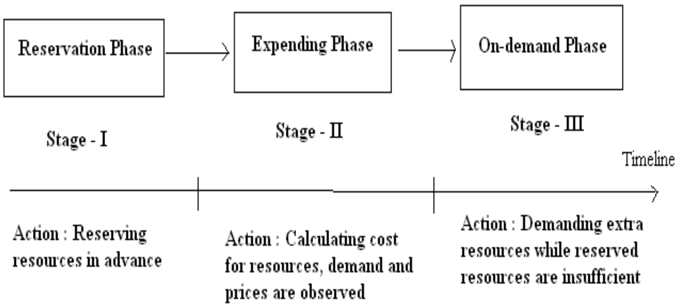

Fig. 3 Transition of Provisioning Phases

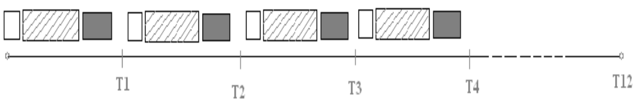

Fig. 4 Observance of uncertainty parameters in every phase

Normally one year will be divided into 12 monthly plans i.e., 12 provisioning stages, in each and every stage the reserved, utilized and extra demand will be analyzed. The uncertainty parameters are price at the provider side and the demand at the consumer side are analyzed in every stage.

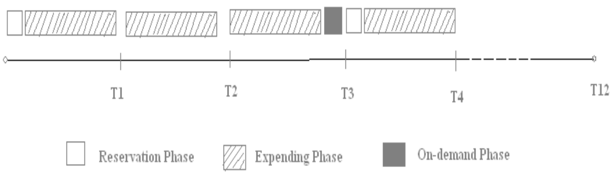

Fig. 5 utilizing resources based on uncertainty parameters

In Fig.4 each and every stage the resource usage and demand requirement will be observed, based on that in next iteration the utilization and reservation of resources will happen.

E. Provisioning costs

The main objective of the OCRP algorithm is to minimize the total provisioning cost. The cloud provider provides details of the cost per instance as it represented in dollars ($). The representation as following: *r*- Resource type, *k*- Reservation contract, *j*- Cloud provider, *i*- Virtual machine index, *ω*- Scenario index, *t*- Provisioning stage index. For provisioning every resource type, the resource cost follows:

$$C_{ijk}^{(R)} = \sum_{r \in R} b_{ir} C_{jkr}^{(R)}$$

If consumer provisions the resources more than reserved, he will go for on-demand resource provisioning because of uncertainty parameters. This on-demand provisioning cost will be added to the total provisioning cost. Uncertainty parameters are price and demand, Price cannot be fixed one because due to the power provided by CSP, may be increased in next few months and some other fluctuations may occur in price. Similar to that the consumer cannot exactly able to tell how much resources required executing their particular job. On-demand unit cost will be higher than the reservation unit cost. i.e., $C_{ijkt}^{(o)}(\omega) > C_{ijkt}^{(r)}(\omega)$.

V. IMPLEMENTATION

The strong security is most important in many services, such as e-commerce and telemedicine and other services. The public information can function with much less security. The security strength of the security mechanisms depends upon how its ability to break that particular mechanism. Multifactor authentication is difficult to compromise than single-factor authentication methods; it significantly increases the complexity of the authentication process for the user. Other methods to increase authentication strength, such as longer passwords, more complex password composition, or more frequent password changes and so on.

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Resource provisioning done through OCRP algorithm. This algorithm utilizes the stochastic integer programming method to optimize the resource cost.

Table.1 Notations for Stochastic Integer Programming

R- Set of resource type, $r \epsilon R$
I- Set of virtual machine (VM) class index, $i \epsilon I$
J- Set of cloud providers, $j \epsilon J$
K- Set of reservation contracts, $k \epsilon K$
T- Set of provisioning stages, $t \epsilon T$
Ω- Set of scenarios, $\omega \epsilon \Omega$

b_{ir} – Amount of resource type r required by VM class i
$C_{ijk}^{(R)}$ – Reservation cost charged by the cloud provider j to consumer VM class i
$C_{ijkt}^{(r)}(\omega)$ – Reservation cost charged by the cloud provider j to consumer VM class i at scenario ω in provisioning stage t.
$C_{ijkt}^{(e)}(\omega)$ – Expending cost charged by the cloud provider j to consumer VM class i at scenario ω in provisioning stage t.
$C_{ijkt}^{(o)}(\omega)$ – On-demand cost charged by the cloud provider j to consumer VM class i at scenario ω in provisioning stage t.
$d_{it}^{(\omega)}$ – Demand required to execute VM class i at scenario ω in provisioning stage t.
$a_{jrt}(\omega)$ – Maximum capacity of resource type r provided by provider j in provisioning stage t.
$x_{ijk}^{(R)}$ – Decision variable representing the no. of VM classes i provisioned in reservation phase.
$x_{ijkt}^{(r)}(\omega)$ - Decision variable representing the no. of VM classes i provisioned in reservation phase in provisioning stage t and scenario ω.
$x_{ijkt}^{(e)}(\omega)$ - Decision variable representing the no. of VM classes i provisioned in expending phase in provisioning stage t and scenario ω.
$x_{ijt}^{(o)}(\omega)$ - Decision variable representing the no. of VM classes i provisioned in on-demand phase in provisioning stage t and scenario ω.

A. *Stochastic Integer Programming*

Minimize: $z = \sum \sum \sum C_{ijk}(R)\, x_{ijk}(R) + IE(\,Q(x_{ijk}(R),\omega))$ (1)

Subject to: $x_{ijk}(R) \epsilon IN0$, $i \epsilon I, j \epsilon J, k \epsilon K$ (2)

$$Q(x_{ijk}(R),\omega) = \min_{Y=(x_{ijkt}(r)(\omega),\, x_{ijkt}(e)(\omega),\, x_{ijt}(o)(\omega))} C(Y) \quad (3)$$

Simply, $Q(x_{ijk}(R),\omega) = \min C(Y)$ (4)

Where,

$$C(Y) = \sum_{i \epsilon I} \sum_{j \epsilon J} \sum_{k \epsilon K} \sum_{t \epsilon T} C_{ijkt}(r)(\omega) x_{ijkt}(r)(\omega) + \sum_{i \epsilon I} \sum_{j \epsilon J} \sum_{k \epsilon K} (\sum_{t \epsilon T} C_{ijkt}(e)(\omega) x_{ijkt}(e)(\omega) + C_{ijkt}(o)(\omega) x_{ijt}(o)(\omega))$$

Subject to, $x_{ijk}(R) = x_{ijkt}(r)(\omega)$, $t=1, i \epsilon I, j \epsilon J, k \epsilon K$ (5)

$$\sum_{j \epsilon J} (\sum_{k \epsilon K} x_{ijkt}(e)(\omega) + x_{ijt}(o)(\omega)) \geq d_{it}(\omega), \quad i \epsilon I, t \epsilon T \quad (6)$$

$$\sum_{i \epsilon I} b_{ir} (\sum_{k \epsilon K} x_{ijkt}(e)(\omega) + x_{ijt}(o)(\omega)) \leq a_{jrt}(\omega), \quad j \epsilon J, r \epsilon R, t \epsilon T \quad (7)$$

$x_{ijkt}(r)(\omega) \epsilon IN0$, $i \epsilon I, j \epsilon J, k \epsilon K, t \epsilon T$ (8)

$x_{ijkt}(e)(\omega) \epsilon IN0$, $i \epsilon I, j \epsilon J, k \epsilon K, t \epsilon T$ (9)

$x_{ijt}(o)(\omega) \epsilon IN0$, $i \epsilon I, j \epsilon J, k \epsilon K, t \epsilon T$ (10)

Fig. 6 Stochastic Integer Programming

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Minimization of the total provisioning cost achieved through the stochastic integer programming. The objective consists of the reservation cost as well as on-demand cost basis on certain conditions given above. In equation (3), the minimization focus on the variables $x_{ijkt}^{(r)}(\omega)$, $x_{ijkt}^{(e)}(\omega)$, $x_{ijt}^{(o)}(\omega)$ in reservation, expending, on-demand reservation phases. C(Y) obtained by multiplying unit cost with decision variable in all three provisioning phases.

The expending and on-demand requirement will be more than the demand required to execute a particular VM classes in equation 6. For eg, provider having storage splitter into 5MB segments, consumer reserved 20MB which is not enough to execute job he additionally needs 7MB to execute. Consumer requests provider on-demand basis, provider provides 10MB to execute the job (i.e., 27MB $\geq$ 30MB). In equation 7, the cost multiplied with the amount of resource could be less than the maximum capacity provided by the provider. The decision variables used in 3 provisioning phases are integer values. Deterministic equivalent formulation will be similar to the stochastic integer programming with probability distributions.

VI. RESULTS AND DISCUSSION

The particular cloud provider who enters into the cloud environment and register their resource details how much and what type of resources are available with them. The cloud provider also provides details about small, medium, large instance and cost per particular instance.

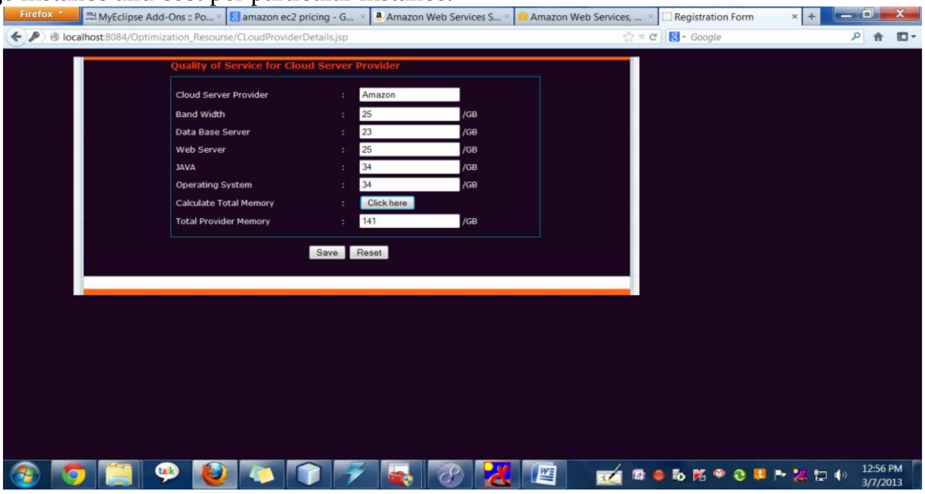

Fig. 7 Cloud provider resource details

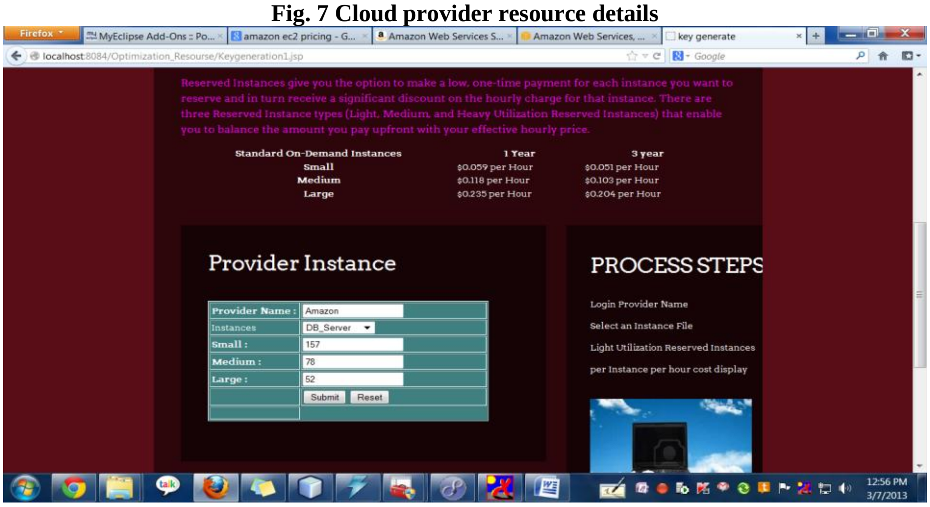

Fig. 8 Cloud provider Instance details

The consumers view that particular provider details and he will reserve the resources. On-demand security files are divided into 3 levels: normal, medium, high level security. Basically in normal level all public information will be present without any security mechanism the user can access it. In medium level, particular user login and upload their files with security question that file can be downloaded by only knowing answer to that question. In the user module, we can see which file is uploaded in which user login at which level the particular file is stored.

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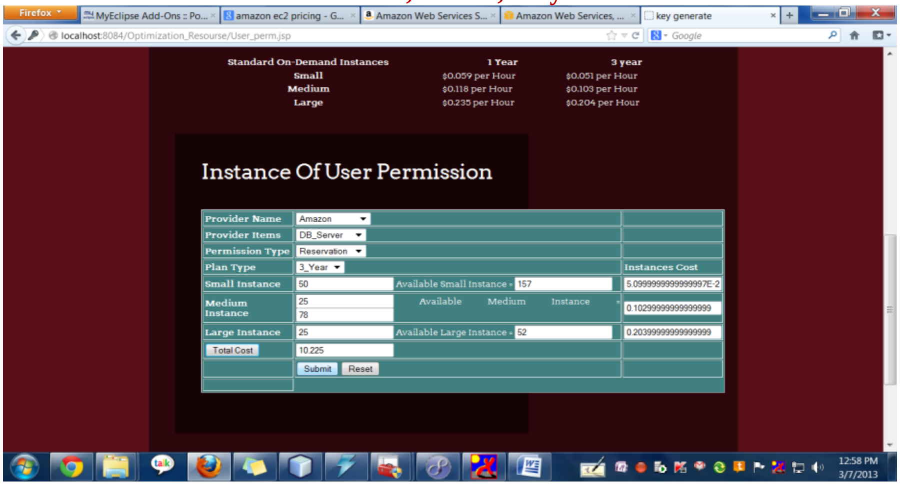

Fig. 9 Resource cost calculation

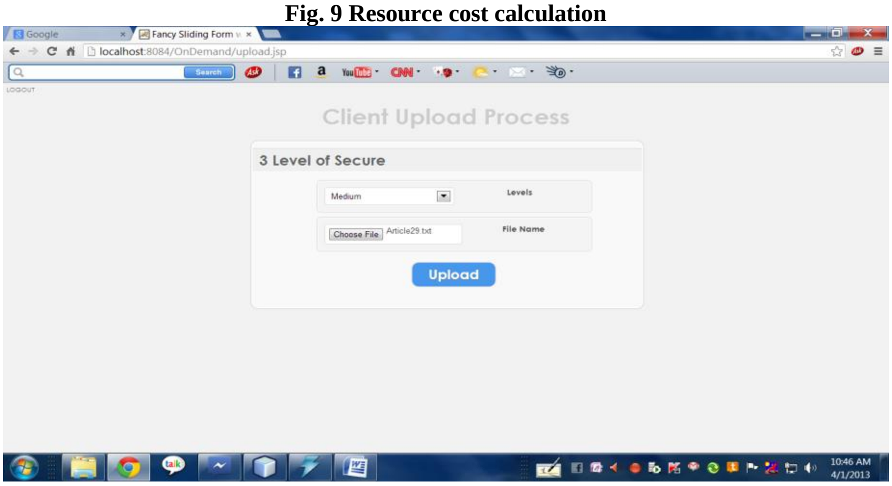

Fig. 10 On demand security levels

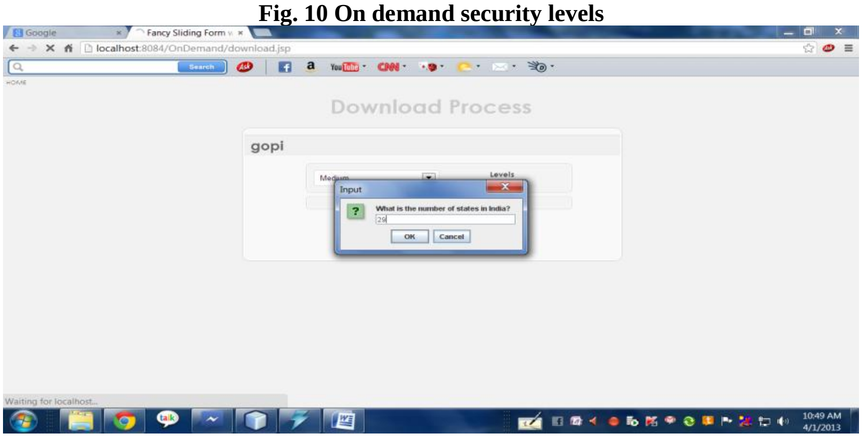

Fig. 11 Accessing files in medium level

VII. CONCLUSION

The security policy provides security on demand, there is no need to adapt security mechanisms for every domain. Segregating user resources during data processing to prevent widespread virus infection. On-demand security is a much better fit because it automatically differentiates security strength of the resources according to service type, the security level that users specify, and access network risk. Resource provisioning on demand security architecture provides a best security mechanism to protect the cloud resources. This work focus on the optimization of the resource provisioning cost by stochastic integer programming method. The main objective

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here is to reduce the total provisioning cost. The future work focus on resource provisioning optimization by simplex optimization method.

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