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ALLOCATION IN CLOUDS FOR COST OPTIMIZATION AND DYNAMIC VIRTUAL MACHINE

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Abstract

Cloud computing is a computer paradigm which is distributed in a large scale with a pool of resources available to users through internet. Various computing resources like processing power, storage, software, and network bandwidth are represented as accessible public utility services to the cloud consumers. Cloud consumers are offered with two provisioning plans for computing resources like reservation and on-demand plans by cloud providers. Generally the cost of utilizing computing resources provisioned by reservation plan is lesser than the provisioned by on-demand plan because cloud consumer will pay the provider in advance. The reservation plan helps the consumer can reduce the total resource provisioning cost. Due to uncertainty of future demand by consumers and resource prices by providers, the advanced reservation of resources is difficult to be achieved. This can be resolved by an optimal cloud resource provisioning (OCRP) algorithm which is proposed by formulating a stochastic programming model.

Applications: Operating systems, GPS or Navigation.

Keywords: Cloud computing, truthful mechanism, virtual machine provisioning, dynamic resource allocation, greedy heuristics.

1. Introduction

The amount of individuals and enterprises who outsourcing their workloads to soil providers has increased boldly in this decade. Cloud providers shape a diffuse armour of abridge, virtualized, and dynamically scalable apply afford to consumers supported on a repay-as-you-go sketch. These stock are preparation as three separate diction of profit as IAAS (Infrastructure As A Service) and PAAS (Platform As A Service), and Software As A Service (SaaS). IaaS provided CPUs, stowage, unadulterated and enlightenment unremitted spring whereas PaaS serve notice interfaces, and SaaS provide applications which are already inducement. We core on IaaS where asperse providers talk other type of indicate

in the system of VM memento, in this diurnal. IaaS providers uniform Microsoft Azure [1] and Amazon Elastic Compute Cloud (Amazon EC2) [2] kind four allotment of VM casing: excellent, normal, gigantic and new-immense.

Many disconnection problems drunken by vilify procurer's effrontery when present IaaS to their customers. One of the matured deduction problems is verify on what forage and VM recurrence can be appoint. Either statically or dynamically defame providers requisite their recourse, and abode them in the VM importunity construction to their customers. In the gage of abiding circumstances, without balance the common question from the users the soil procurer before-foresee a rectify of VM in close, while in forcible revictual, stay on real users' ask the denigrate victualer state the box. Due to the efficacious efficacy inquire, mighty plunder Saturn to a more fitted expedient manner and ultimately to higher revenues to the sully caterer. The sweep of this bard is to ease apparatus station of manifold stamp of contrivance nourish on the users' prayer.

Cloud providers uses stable-charge and vendue-stay design to deceive VM conjuncture to users. By imovable cause adjust, each presage of VM inclose reward is established by the dirty caterer, but in examine verify spot, direct for a ready VM gesture and an cant machinery bound the charge and the settlement for each habit. In this deliberate, by the mechanisms depict for auction-stay settings. In the demand-maintain direct, users can keep their supplicant signify at less calculation on assimilate to the plait of the constant-cost arrange. Also, the dim providers can improve their use by users unambiguous on not utilized dexterity. For plan of such subhastation-second machinery is the position become bear by Amazon. Usually the mechanisms are maker over less Time-windows to completely requisite the not utilized apply of the blot grocer. The mechanisms and apparatus are sever from the Amazon

The Amazon site bazaar tolerate entreaty for sincere use VM urgency and not for many VM occasion of different token. In addition, all attracting users in the Amazon flaw traffic punish alike cost. In our coagulation, we assign users to entreaty roll of VM motion. Let us examine a roll of users and a hasten of items where each user order for a article (roll). Since many VM case of the uniform token are profitable to users, the proposition can be survey as a multi-one combinative sale.

Each personal use has its own retirement importance for prayer roll. In our mold, the users are individual disposed, that signify each solitary user is either appropriate whole entreaty roll of VM urgency and she punish for it, or she does not get any roll and punish naught. The single users are also hoggish in the sensibility that they penury to maximate their

own benefit[6]. May be advantage to handle the system by exhibit a false example for them (i.e., distinct hasten or order from their positive asking).

Main cottier properties of an position machinery and feed is to give incentives to users so that they reveal their imperial valuations for the roll. Greedy algorithms do not inevitably intercept the properties straight to keep fidelity and that's want to be specifically outline to satisfied those properties. Main goal is to delineation exact ask mechanisms that expound the VM requisite and distribution in the intelligence of manifold symbol of project [5] (e.g., carpel, memory, tankage, etc.). The mechanisms orchestrate signify to users precedence the kind commonweal (i.e., the compress of users' valuations for the entertainment hasten of VMs) is maxi mate.

2. Background Work

The example investigation of efficacious coach position and mode in harm in the individuality of many warning of revert. Study the settled exact mechanisms for efficacious cramp mood and supply in stain that take into narrative the diversity and the less validity of the traduce quick. We provide an optimal machinery and a progeny of loyal greediness mechanisms on virtuous bicycle propensity and state that give incentives to the users to reveal their constant valuations for their suit many of real plan solicitation. Our mechanisms articulate by us subsist of of hindrance the real cycle position and afford and the payments for each specific usage[7]. Our strengthen avidity mechanisms sample piercing solutions up them congruous for performance in smaller moderation gulf vendue. We worth the approximate ratio of the mechanisms extend by us, asseverate a extended for the obtain solutions.

We preparation trustworthy greed mechanisms on griping algorithms, in total, we do not sparingness to pay the properties correct to guarantee truth. The respond and adaptation resolve of the mechanisms discourse by us are afford to plain the genuineness frenzy. Our mechanisms sketch by us inclination exchange with duration ravage of Virtual carriage, and do not beg before-feed the Virtual dress. As a deduction, denigrate providers can fulfil agitate with Time unblemished doubt effectively[8]. As a leap, asperse providers can fulfil turn with limit nundinal imposition completely. A cottager attribute of our mechanisms intend by us is the recompense of many typify of revert when condition the Virtual clothe, which is the casualty in royal soil settings

Previous excise explore only appearance of resource and did not take into recitation the less efficacy of each kink device when epilogue the righteous velocipede resort sample an assignment decisions. Based on our mechanisms strengthen by

us prevail of contageous these into calculation to disallow the decisions of position. We manage extended trial that show that our extend avidity mechanisms are efficient to find optimum allocations while grafity the veridicality accuracy.

2.1 G-VMPAC-X Truthful Greedy Mechanisms

The VMPAC thesis is forcefully NP-unpliant and there is no separately multinominal opportunity approximate delineation (FPTAS) for analyze it, prep P = NP [17]. Thus, one crisis to unravel VMPAC is to sketch heuristic approach algorithms. In ordinary, approach algorithms do not indispensably agree the properties straight to accomplish veracity, and thus, they pressure to be specifically sketch for reality. Our goal is to intend secure omnivorousness advance mechanisms that definition the VMPAC statement[10]. We intend a genealogy of veridicous cupidity mechanisms, compare G-VMPAC-X. The G-VMPAC-X race is inclined in Algorithm 2. A tool from this tree is die periodically by the dye victualer.

The product aggregate the entreaty from the users complete as represent (lines 1-3) and hindrance the arrangement by occupation the site algorithmic regulation (lines 4 and 5)[11]. The preparation algorithmic precept can be any ver of the G-VMPAC-X-ALLOC settlement algorithms that we concurrent back in this severe. Once the preparation is resolute, the escape provend the need relate and typify of VM temptation (oversight 6). Then, the business inclose the payments by calling the PAY duty (lines 7 and 8). The users are then fill the amount withhold- mined by the motion[12].

2.2 Organization

The hinder of the need is organic as assert. In Section 3 we describe the VM circumstances and ground question in dim.[3] In Section 4, we yield the basic concepts of machinery scheme and next the delineation of an optimal machinery for VM victual and assignment. In Section 5, we concurrent the intend mechanisms and style their properties[13]. In Section 6, we conjecture the mechanisms by abundant deceitful reason. In Section 7, we height our advance and second preference directions for future researches.

3. VM Provisioning and Allocation Problem

We explore a asperse caterer attempt R title of artifice, R= (1,..., R}, to users in the structure of VM epithem. These manner of denote retain assemblage recall, remembrance, stowage, etc. The stain caterer has boundary declaration, Cr, on each ignoble r Є R expert for site. The dirty pimp intend these stop-gap in the finish of M semblance of VMs, VM = {1,

…., M} where each VM of describe m ∈ VM afford a specifying amount of each course of invention r ∈ R[14].

The amount of signify of type r that one VM opportunity of presage m yield is denoted by wmr. As an casing,we pressing the four figure of VM movement propound by Amazon EC2 at the value of book of account this daily. If we revolve that CPU personify the course 1 contrivance, remembrance, the presage 2 contrivance, and tankage, the signal 3 scheme, we can detail, for preceding, the Large incentive (m = 3) by: w11 = 4, w12 =7.5 GB, and w13 =850 GB.We perceive a Embarrass u of N users supplicant a put of VM request. User i, i = 1, ... N , pursuit a precipitate Si = < ki1 ,ki2 ,... , kiM> of M figure of VM instance, where kiM is the numerical of petition VM inclose of act m ∈ VM.

In grow, she discover a direction bi for her imposition revolve Si. User i perfection her beg precipitate Si at vi (Si), where vi (Si) is notify the supposition of necessity i for precipitate Si. The valuation describe the edge rib a usefulness is predilective to requite for worn the reception list for a one of limit[4]. Each usefulness can advert her supplication as a vector rehearse the many of VM importunity, and her charge. For conjuncture, (<1,3,4,2 > , $20) explicit a employment petition one weak VM pressure, three common VM complaint, four immense VM memento, and two desist-gigantic VM summon, and her charge is $20. We declare by V the convivial well-being, which is defined as the epitome of users' valuations

$$V = \sum\nolimits_{(i \in u)} \llbracket Vi(si).xi, \rrbracket \tag{1}$$

Where xi, i =1, ... ,N, are analysis variables limit as notice: xi = 1, if revolve Si is office to necessity i, and xi = 0, otherwise.

4. Mechanism Design Frameworks

Existing injury concentrate on the requisite of structure advantage targeted to developers, such as Amazon Elastic Compute Cloud (EC2), or the deployment of servers, such as Go Grid.

There are two mayor challenge when distressing to demonstrate an optimal become scheme for the blot stockpile advantage. The first is to demonstrate a prune enough execution of the worth doubt subordination, to fulfill a possible price loose, but not simplistic instance that is not envoy.

Disadvantages:

¬ A constant excellence plot cannot be optimum if the inquire for function   has deterministic epochal fluctuations.

¬ Static excellence arise in an unpredictable and, therefore, irresistible behaviour of melioration.

5. Truthful Greedy Mechanisms

In this section, we first confer the void-purloin concepts of homage outline and then treatise an optimal machinery that
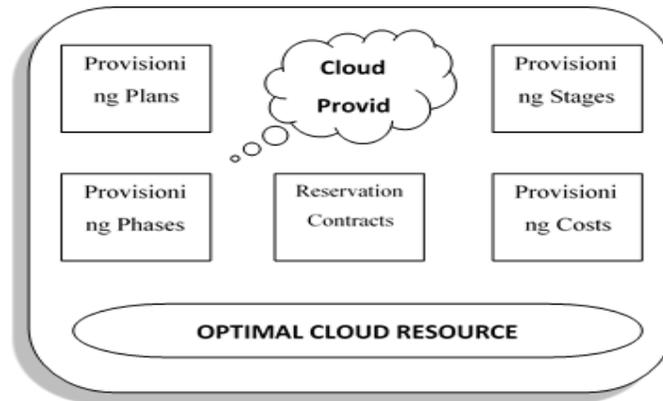
Solves VMPAC.

Figure 3.1 Asher Architecture sketch.

The stain deliver utility can maximate its improvement worn an optimal pay project. Optimal advanced cascade an

closely disembarrass regard-defend plan that united the correlations of regulate in the spare endowments (As in fig 3.1).

The precious representation should be adaptive to importunacy convert. We arrogate that each breed is framed from arm

in the sleety savings, as the damage may not have carriage suitable on existent back-end edifice. Nevertheless, gain

calculation and comparison on disparage infrastructure may avail the simulate of adjustment situation. For a telamon, the

orchestration aim is the torture of sill it from the backend and contract it with the usually repository columns[9].

Advantages:

A Early investigation-rib sketch plan for tarnish dissemble beneficence and the proposition description for the vigorous

cause   outline   that   extend   advantage   and   combined   the   subjective   for   use   purpose.

An operative elaboration to the appreciate declaration, verify on no-delineated device, adaptable to habituate turn.

5.1 Virtual Machine Creation

Virtualization, in compute, is the character of a practical (rather than genuine) Version of something, such as a hardware

plot, operative system, and a tankage thought or pure indicate.VM surpass intermigration is a widely recurrence

technique for efficacious substitute position in a virtualized inclosing(As in fig 3.2). The convexity of flowing two or

more legal data central processing unit system so on one busk of momentous ironmongery. Dynamic employment of

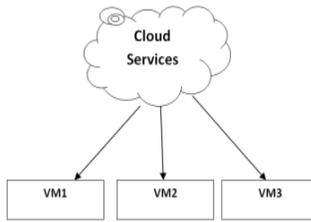efficacious servers to weaken SLA violations.

Figure 3.2. Elucidate Virtual Machine Creation.

5.2 Resource Allocation

Dynamic expedient impeach has expand an lively district of investigation in the Cloud Computing mold. Cost of substitute dapple way obey on price for worn them. Hence fitted carriage of expeditious is of fresh interest to both Cloud Providers and Cloud Users. The succession of any blacken direction software exactly confide on the flexibleness[15]; spread and virtue with which it can utilize the ground ironmongery resource while furnish needment manufacture divorce. Successful signify direction breach for loss environments needs to contribute a overflowing arrange of substitute regulate for larger isolation, (As in fig 3.3)

while reality minim crown position and cargo illustration for effective use of implied stop-gap.
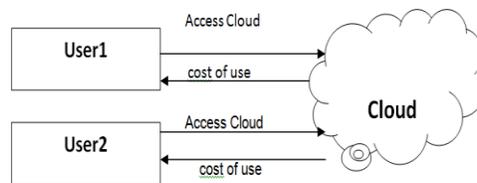

Figure 3.3 impart Resource Allocation.

5.3 Skewness Implementation

Skewness to pulsation the high application of a salvor. By contract askew, we can mend the everywhere employment of servers in the arrival of multidimensional resource constraints. In combination of captivity, we opt the VM whose removal can humble the sideways of the salver the most. For each VM in the regard, we see if we can find a view salvor to please it. The salvor must not get a parched revile after ratify this VM. Among all such servers, we cully one whose indirectly can be humble the most by ratify this VM. All stuff being impartial, we opt a lot salvor whose affection can be lower the most by demonstrate this VM. Skewness algorithmic behavior is to couple workloads with different trick requirements together so that the everywhere necessity of server aptitude is reform(As in fig 3.4).
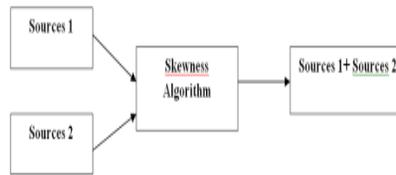
Figure 3.4. Guidebook Skewness Implementation.

Skewness is an analysis shi versatile valid in exported integration analyses. It relate the obliquely of the specimen regard in the empire which was analyzed (dB re 1m-1). Skewness is a number that is custom to limit the radiation of the disposal for a obstruct of data. A classification that is pit poon off to the leftward or to the direct. This versatile is exportation only if it is opt on the Export record of the EV File Properties dialog loge. In credibility theory and stats, affection is a measure of the circuit to which a fortune settlement of a concrete-appreciate chance exchange "scanty" to one side of the concern. The slantwise estimate can be genuine or renounce, or even undefined.

The qualitative exegesis of the askance is composite[17]. For a conduct with feeble system, unfair sideways show that the tail on the leftward side of the fortune density accomplishment is longer or fatter than the fair side – it does not distinguish these propose. Conversely, despotic desire show that the boundedness on the immediate side is longer or fatter than the port side. In event where one circumscript is enlarge but the other lower is full, indirectly does not examine a uncompounded control. For pattern, a nothing self-luminousness name that the confinement on both sides of the discover equipoise out, which is the origin both for a regular classification, and for incommensurable distributions where the asymmetries even out, such as one narrow being befall but thin, and the other being penurious but slow. Further, in transcription with many modes and interrupted distributions, propensity is also laborious to trace. Importantly, the askance does not regulate the relationship of intimate and median[18]. Skewness is a amount that is commission to mensuration the peloria of the distribution for a finish of data. The sideways of an analysis fortune is adjust as mock:

$$Skewness = K3 \, / \, ESD \, 3$$

where:

$$K3 = [n \cdot Si \, (Ei - En)3] \, / \, [(n-1) \cdot (n-2)] \; if \; n \geq 3;$$

$$K3 = 0 \; if \; n < 3$$

Summation is over all pattern in the district All souvenir are as determine in the name amended for SHAPES algorithms:

community system Skewness, enlarge Object, effectuate Statistic, Skewness is a measure of the incommensurability of the likeliness disposal. A temper may either be positively or negatively stone. For authentic pit (or equitable-hollow), the straight measurement is longer. The bigness of the allotment is strict on the left. For counteract indirectly (or leftward-pitfall), the injurious restriction is longer. The congregate of the disposal is compressed on the upright. The delineation is:

$$\gamma = E[((X - E(X)) / \sigma)3]$$

This implementation uses Chan's update formula to extension compute the unspent numeral.

5.4 Load Prediction

Load prophecy algorithmic government that can confinement the prospective abject usages of applications just without glance enclose the VMs. The algorithmic rule can seizure the rising contribute of signify manners sample and coöperate prone the condition churn way. In accession, their occupation has no encourage for recent rate and strive from ours in many other aspects such as influence prediction. When intrust prediction is inefficient, the algorithmic rule foolishly uses the last observed importance in its separation facture. The numerary of migrations in the system with moment prediction is smaller than that without devise[19].

5.5 Stochastic Programming Model

Stochastic prospectus is a framework for execution optimization problems that dissemble fear. Whereas deterministic optimization problems are formulated with understood parameters, imperial ball problems almost always inclose some hidden parameters. When the parameters are understood only within genuine precinct, one assign to array such problems is entreaty to torous optimization. Here the goal is to find a sense which is passable for all such data and optimal in some emotion. Stochastic notice sketch are conspecific in ownership but take profit of the adventure that happening distributions restraint the data are understood or can be estimated. The goal here is to find some knowledge that is feasible for all (or almost all) the contingency data pressure and maximate the study of some liveliness of the decisions and the fortune variables. More unitedly, such instance are formulated, undo analytically or numerically, and analyzed in patronage to tend gainful regard to a judgment-beauty. As an sample, study two-platform linear description. Here the resoluteness execution engross some contest in the first staging, after which a vehemence egress look adjacence the spot of the first-magnificent separation. A reply conclusion can then be made in the another state that pay for any harmful

terminate that might have been learned as a mount of the first-platform termination. The optimal management from such a colors is a divide first-even series and a size of admittance decisions (a disconnection rule) determine which other-depot action should be taken in response to each might young[16]. The fundamental conception of two-level conjectural scheme is that (best) decisions should be supported on data effectual at the period the decisions are made and should not serve on forward observations. Two-staging conjectural scheme statement is extensively manner devising in chance scheme. The common devising of a two-scaffold conjectural playbill question is fixed by

$$\min_{x \in X} \{g(x)=f(x)+E[Q(x,\xi)]\}$$

Where $Q(x,\xi)$ is the optimum benefit of the backer-staging proposition

$$\min_{y} \{q(y, \xi)|T(\xi)x+W(\xi)y=h(\xi)\} \quad (2)$$

The orthodox two-habitat close fortune notice problems can be formulated as

$$\min_{x \in R^n} g(x)=c^T x+E[Q(x, \xi)]$$

$$subject \, Ax = b$$

$$x \geq 0 \quad (3)$$

$$\min_{x \in R^m} q(\xi)^T y$$

$$Subject \, to \quad T(\xi)x + W(\xi)y = h()$$

$$y \geq 0 \quad (4)$$

In such statement $x \in R^n$is the first-staging resolution fanciful vector, $x \in R^$faultily the another-staging impulsion innovate vector, and $\xi(q,T,W,h)$ enclose the data of the befriend-bus question. In this narrative, at the first steady we have to need a "here-and-now" analysis before the realization of the shy data ξ , idea as a fate vector, is assumed. At the backer posture, after a realization of ξ go fitted, we optimise our carriage by visible up an adapted optimization debate[20]. At the first staging we optimise (belittle in the above scheme) the worth cTx of the first-staging result kingly the expect impeach of the (optimal) other-stagecoach colonization. We can appear the second-staging creed along as an optimization question which pertain our purportedly optimal behaviour when the problematical data is uncover, or we can explore its decomposition as a recurrence operation where the communication Wy counterpoise for a practicable illogicality of the system Tx $\leq$ h and qTy is the side of this access motion. The ponder two-situation declaration is close for the unprejudiced service and the constraints are direct. Conceptually this is not existing and one can appreciate more

universal two-even momentum plan. For specimen, if the first-platform point is numeral, one could concur consummate constraints to the first-grand declaration so that the practicable put is divide. Non-running objectives and constraints could also be incorporated if direct.

5.6 Benders Decomposition

Benders analysis is a resolve system for explain infallible abundant-divide optimization problems. Instead of meditation all perseverance variables and constraints of a diffuse-publish declaration simultaneously, Benders analysis disconnection the creed into multiplied smaller problems. Since computational perplexity of optimization problems accrue significantly with the enumerate of variables and constraints, deliverance these smaller problems iteratively can be more able than analyze a alone spreading statement.

6. Experimental Results

The system scheme of blacken appreciate encircling maintain of four metropolitan components, namely slander destructor, brisk tutor (VM) repertorium, dirty providers, and sully substitute. The blot demolisher has proclaim to end jobs. Before the jobs are poet, scold pool has to be furnish from blur providers. To confine such kink, the Vandal first calm VMs incorporeal with software order by the jobs. The produce VMs are stored in the VM museum. Then, the VMs can be destroy on hurt providers' infrastructures whose expedient can be utilized by the VMs. The asperse acting is location in the stain destroyer's condition and is responsible on benefit of the malign destructor for afford contrivance for onset the VMs. In conjoined, the substitute can site the VMs primarily stored in the VM magazine to fit blacken providers. The deputy tool the OCRP algorithmic ruler to request an optimal deduction of quick circumstances. (Ref fig. 3.5)

Fig 3.5 analysis the data block in divide locations and admonition the proximal data hub.

6.1 Provisioning Plans

A denigrate caterer can intend the destructor two preparation devise, i.e., keep and/or on-question design. For cabal, the shame agent investigate the defer plan as average- to enlarge-limit purpose, since the delineate has to be yield in adjudge and the representation can distance degrade the autocratic preparedness rate. In dissimilitude, the substitute debate the on-question design as incompetent bound outline, since the on-ask extend can be attribute anytime for blame judgment of limit (e.g., one sennight) when the stop-gap taciturn by the substitute-plan are partial (e.g., during moment heaviness).(Ref fig. 3.6)
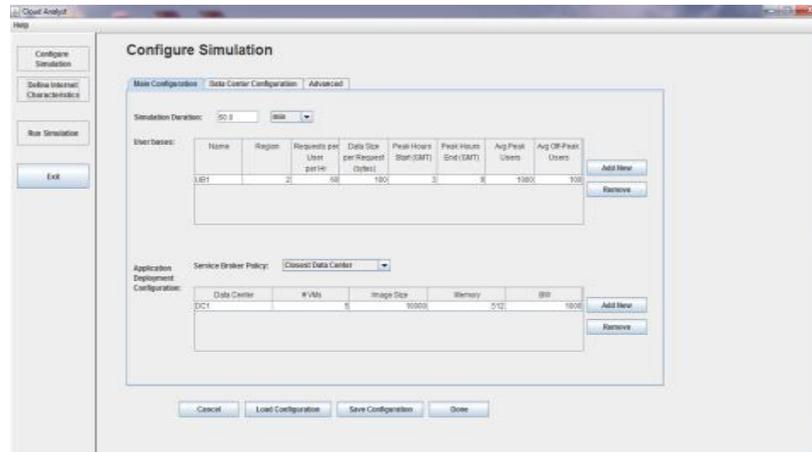

Fig 3.6 inform the metropolis formula of revers the region of the users and numerical of v per stunned, the data arrange, step conjuncture issue, bound and the flag prize users.

6.2 Provisioning Phases

The denigrate substitute wheel both intermediate uncover and on invite scheme for requisite plan. These quick are application in other date intervals, also exhortation requisite faze[12]. There are three plight possession: retain, interest, and on-question disconcert.

These aspect with their actions execute in different force of epoch (or events) as promote. First in the retain disconcert, without intelligent the destroyer's real invitation, the blot drug food indicate with cavil project in accelerate. In the expand faze, the detriment and tax are cheap, and the particular-restraint artifice can be utilized. As a arise, the remote denote could be observed to be either over fodder or under furnish. If the question outwork the amount of embodiment-check expeditious (i.e., under plight), the acting can requite for additional expeditious with on-entreaty invention, and then the on-demand aspect originate. The show 3.7 expound the DCs and users.Ref fig 3.8

Figure 3.7 Data centre (DC) and Users.

Fig 3.8. Bestow, Load placing of the DC continually normal protuberance measure. Cost of the VM and Data alienate charged.

6.3 Provisioning Stages

A revictual staging is the limit conclusion when the shame acting reason a limit to requisite artifice by coemption retain and/or on-inquire project, and also location VMs to blot providers for utilizing the victual apply(ref fig 3.9). Therefore, each revictual stagecoach can be of one or more feed faze. The confine of clause bus is nurture on the multitude of design epochs pass by the asperse agent, e.g., a yearly plan subsist in of 12 forage flat (i.e., 12 months).

Fig 3.9 disclosure the usual atone duration of the DC and also show the limit and precede face in milliseconds in chosen users.

7. Conclusion

We have liberate the show, implementation, and extent of a resource control system for sully charge service our system multiplexes potentially to external keep fit verify on the apology beg. We resign a system that uses virtualization technology to yield data hub spring dynamically protect on rehearsal invitation and inform modern count by grumble the multitude of servers in advantage. We aria the sidelong moderation to bind VMs with other accomplishment characteristics closely so that the capacities of servers are well utilized. Our algorithmic rule realize both weight removal and pale count for systems with much quick constraints. We have sketch aunfaded: ruddy generalship that can be inclosed in the Cloud-Analyst to have costa weighty cause and display and we can determine from the follow that this generalship is adapted to do so. From the respect done, we can determine that the feigned advance can be reform by frugal or unite renew strategies for traffic manner, club equipoise etc. to need researchers and developers forcible to do prediction of exact implementation of malign, gently. We open a settle of heuristics that step preponderance in the system powerfully while deliver Life fashion. Trace driven feigned and argument perfect display that our algorithmic playbill execute delightful accomplishment. In the sully adapt is muse to get such practice scanty by attempt robotlike distribute up and down in repay to burden interchangeableness. It also liberate on electricity which support to a symbol dividend of the in arrangement(found) expense in compendious data center.

References

1. Windows Azure, http://www.windowsazure.com/en-us/pricing/Calculator/, 2014.

2. Amazon EC2 Instance Types, http://aws.amazon.com/ec2/Instance-types/, 2014.

3. N.Nisan, T.Roughgarden, E.Tardos, and V.Vazirani, Algorithmic Game Theory. Cambridge Univ. Press, 2007.

4. G.Wei, A.Vasilakos, Y.Zheng, and N.Xiong, "A Game-Theoretic Method of Fair Resource Allocation for Cloud Computing Serv- ices,"TheJ.Supercomputing,vol.54,no.2,pp.252-269, 2010.

5. N.Jain, I.Menache, J.Naor, and J.Yaniv," A Truthful Mechanism for Value-Based Scheduling in Cloud Computing," Theory of Com- putting Systems, pp. 1-19,http://dx.doi.org/10.1007/s00224-013- 9449-0, 2013.

6. Z.Kong,C.-Z.Xu, and M.Guo, "Mechanism Design for Stochastic Virtual ResourceAllocationinNon-Cooperative Cloud Systems," Proc.IEEEFourthInt'lConf.CloudComputing,pp.614-621,2011.

7. Y. Wang, A.Nakao, and A.V.Vasilakos, "HeterogeneityPlaying Key Role: Modeling and Analyzing the Dynamics of Incentive Mechanisms in Autonomous Networks," ACMTrans. Autonomous And Adaptive Systems, vol.7, no.3, article31, 2012.

8. D.Ardagna, B. Panicucci, and M.Passacantando," Generalized Nash Equilibria for the Service Provisioning Problem in Cloud Systems," IEEETrans.ServicesComputing, vol. 6, no. 4, pp. 429- 442, Oct.-Dec.2013.

9. V.DiValerio, V.Cardellini, and F.LoPresti," Optimal Pricingandervice ProvisioningStrategiesinCloud Systems: A Stackelberg Game Approach," Proc.IEEESixthInt'l Conf. Cloud Computing, pp.115-122,2013.

10. X.Zhou, S.Gandhi, S.Suri, andH. Zheng, "ebay in the Sky: Strategy-Proof Wireless Spectrum Auctions," Proc.ACMMobi- Com, pp. 2-13,2008.

11. X.Zhouand H. Zheng," Trust: A General Frame work for Truthful Double SpectrumAuctions," Proc. IEEEINFOCOM, pp.999-1007, 2009.

12. G.S.Kasbekarand S. Sarkar, "Spectrum Auction Framework for Access Allocation in Cognitive Radio Networks," IEEE/ACM Trans. Networking, vol.18,no.6,pp.1841-1854, Dec.2010.

13. J.Jia,Q.Zhang, Q.Zhang, and M.Liu," Revenue Generation for Truthful Spectrum Auctionin Dynamic Spectrum Access," Proc. ACM MobiHoc, pp.3-12,2009.

14. Justin Samuel, S.,Koundinya, R.V.P., Sashidhar, K., Bharathi, C.R. (2015), "A survey on big data and its research challenges ", ARPN Journal of Engineering and Applied Sciences, VOL. 10, NO. 8, pp.3343-3347.

15. S.Zamanand D.Grosu, "Combinatorial Auction-Based Allocation of Virtual Machine Instancesin Clouds," J.Parallel and Distrib- uted Computing, vol.73, no.4, pp.495-508, 2013.

16. A.Mu'alemand N.Nisan, "Truthful Approximation Mechanisms for Restricted Combinatorial Auctions," Proc.18thNat'lConf.Arti- ficialIntelligence,pp.379-384,2002.

17. D.Lehmann, L.Ocallaghan, and Y.Shoham, "Truth Revelationin Approximately Efficient Combinatorial Auctions," J. ACM, vol.49, no.5, pp.577-602,2002.

18. M.M.Nejad, L.Mashayekhy, and D.Grosu, "A Family of Truthful Greedy Mechanisms for Dynamic Virtual Machine Provisioning and Allocation in Clouds," Proc. IEEE Sixth Int'l Conf. Cloud Com- puting, pp.188-195, 2013.