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A Novel Service Broker Policy for e-Governance using Federation of cloud

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Abstract— In the Federated cloud, the load balancing is a main challenge. It distributes uniformly dynamic load among multiple nodes in the distributed system environment. This makes any node not to be overloaded while the other nodes are idle or least load. The proper load balancing techniques improve the performance of cloud and utilize resource efficiently. The present study proposed Extended Performance Optimized Routing Policy service broker algorithm and compares it with the existing service broker algorithms in terms of response time and DC Processing time. The extended Performance Optimized Routing Policy service broker algorithm could be utilized in e-Governance framework that might help to develop the optimal and improved resource utilization. This possesses the scope to accelerate the e-Governance services and distribute the load at the peak hours.

Keywords—Cloud computing, e-Governance, Cloud Federation, Service Broker Algorithm, Load balancing.

I. INTRODUCTION

In distributed computing, Cloud computing is an innovative and emerging computing paradigm that permits the multiple users from different locations to access a shared pool of resources (e.g servers, networks, storages) and services (e.g. platform, software and infrastructure) over the internet and pay as per their use [1][2].

Cloud provides the specialized services e.g. scalability, load balancing, resource utilization and virtualization. Today the use of cloud computing is in demand because it provide the better services to their customers without investing new infrastructure, staff training, licensing software etc. And provide services to user in quick, efficient and optimal services at reduced cost [3].

Cloud computing contains three basic components- clients, datacenters and Distributed servers.
Clients:- Clients can access services through internet.
Datacenters: Datacenters contained a number of servers with the requested applications are placed.
Distributed Servers: - In Cloud computing, for the interaction of cloud end-users the cloud service provider host physical high configuration servers [4].

In the paper we enlighten on load balancing in the federated cloud. The load balancing is the process of distributed system that distribute the load among the nodes equally so that every node in the system work equally and avoid the situation some nodes in the system are heavily loaded and others are idle or having least load. The proper load balancing accelerated the optimal utilization of resource, minimize the job response time, maximize throughput and avoid overload.

A. *e-Governance :-*

The e-Governance is a big project and a large number of applications are running. A large number of users access these applications via internet. Government is proactive to provide efficient, quick and secure e-Governance service to the consumers. To provide the efficient and reliable services to customers in the federated cloud a proper, optimize and efficient scheduling and load balancing policy is required. In this paper we will discuss a Extended Performance Optimized Routing Policy service broker algorithm in federated cloud that will distribute load among the various data centers and reduce response time for users and processing time by the data center.

B Cloud Analyst

To simulate a large scale cloud based applications, Cloud Analyst[5] is a novel tool to simulate the user's request and load on the cloud by the evaluation the number of Virtual Machine for processing and Data Center for storage and management of user's request. The Cloud Analyst consist the following main components [5][6].

Region: To simulate the users request in the whole world, the regions are divided according to 6 continents in the Cloud Analyst.

User Base: It models a number of users grouped as a single unit that generate traffic in cloud analyst simulation.

DC Controller: It is responsible for the management of DC by VM creation or destruction, routing of user's request through internet to VMs.

VM Load Balancer: The DC Controller uses the VmLoadBalancer to balance the load by determining the assignment of VM to the next cloudlet for processing. It uses following load balancing policies.

1. *Round-robin Load Balancer*- Cloud allocates VMs using simple Round-robin policy.

2. *Active Monitoring Load Balancer*: It distributes the equal work load to the available VMs. For that it maintained an index of VMs. It identifies from the table and allocates the least loaded VM.

3. *Throttled Load Balancer:* At any given time, Internet cloudlets are allocated to single VM. If more request group are present and VM is Busy, then the requests wait in queue until next VM become available.

Service Broker: It is responsible of managing routing the user's requests between data centers according to the different policies of service broker. The three service broker policies are

1. *Service Proximity based Routing Policy*: The broker refers a data center index table that is indexed according to region and the broker selects the closest data center from the data centers. It also use the criteria "lowest network latency first" to set the sequence of data centers in the list. If more than one DC are available then it selects randomly [6].

2. *Performance Optimized Routing Policy*: The broker maintain a list of all data center with their latest request processing time and select the data center have the least projected total response time.

3. *Dynamically reconfigurable routing with load balancing*: This policy consider the current execution load in order to scale the application deployment by increasing and decreasing the number of VMs allocated in Datacenters[6].

II. RELATED WORK

In cloud computing, there exist ample of related work on load balancing. Vaishali[7] proposed a round robin selection policy of data center in service broker for the resource utilization and simulate with the tool cloud analyst. It also compared the submitted cloudlet on each data center to conventional data center random selection and proposed data center round robin selection.

Kunal et al. [6] proposed service broker policy to assign the work load to DC using with the concept of proportion weights. The proposed policy consider the efficiency of underlying hardware means large number of VM can be created on that underlying hardware configuration so DC can handle a large number of cloudlets. Hence the advantage of the proposed policy provides effective resource utilization of the data center.

Dhaval Limbani et al. [8] proposed extension of service proximity based routing policy and compare the algorithm with original with the constraint cost, and then the proposed algorithm works efficiently.

Nguyen Xuan Phi et al. [11] proposed Throttled Modified Algorithm(TMA) in his research paper that simulate the algorithm using cloud analyst. The algorithm reduces the response time of VMs and cloud data center processing time.

Ankita Sharma et al. [12] proposed a technique for load balancing in cloud that select the best virtual machine on which the cloudlet will be migrated and tested the algorithm on cloudsim in terms of execution time and energy consumption. The result demonstrated that ACO algorithm is least as compared to TESA in term of execution time and energy consumption.

Our proposed Extended Performance Optimized Routing Policy service broker algorithm will allocate and process the user's request to appropriate DC and minimize response time, DC processing time to gain maximum profit and utilize the computing resources efficiently [9].

III. PROPOSED ALGORITHM & E-GOVERNANCE FRAMEWORK

For load balancing in the proposed framework of e-Governance using federation of cloud, a novel approach is required, so for proper load balancing we will use the extended Performance Optimized Routing Policy service broker algorithm[5] in the proposed framework[10] of e-Governance using Federation of Cloud. In cloud federation, multiple data centers are distributed in different regions [3].

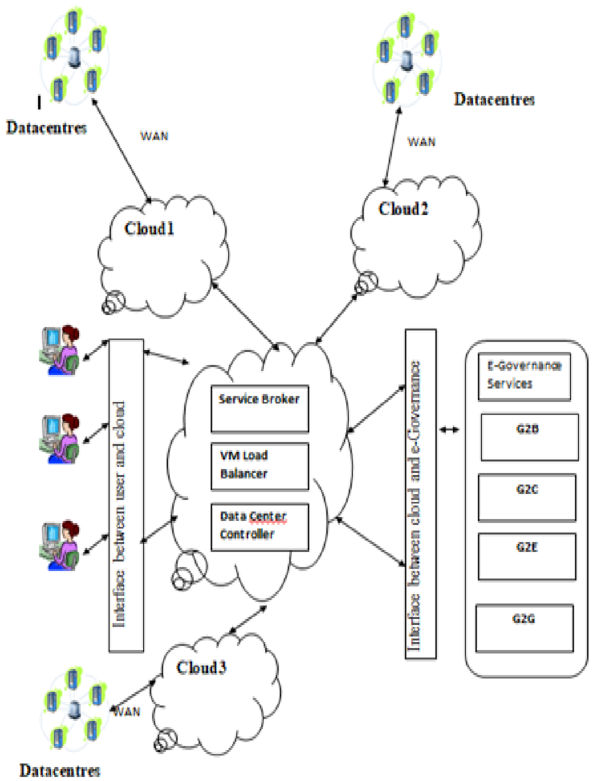

Figure: 1. Proposed e-Governance model with loadbalancing

The proposed e-Governance model in earlier work[10], here the service broker, VM load balancer and Data Center controller play an important role. In the above cloud federated model more than one cloud service provider provides the e-Governance services to the consumers. To manage the Load or traffic at peak hours an efficient load balancing or efficient service broker policy is required. For the e-Governance services the use of cloud make the resource utilization efficiently. Here in the above model a set of data centers are inter connected and some of the data centers are geographically closest to the users and some data centers have the better configuration. Apart from these two parameter the service broker also monitor the current load on the data center so at the peak hour when the load or traffic is high, then the proposed extended Performance Optimized Routing Policy service broker algorithm monitor the data centers for the continuously allocation of user base's request to appropriate Data center that consider the combination of three parameters- location, quickest(high configurable) and least current load so that it minimize the user request response time and Data center request processing time.

In the above study Extended Performance Optimized Routing Policy service broker algorithm is proposed to consider above parameter and this simulated with a Cloud SIM based GUI tools Cloud Analyst. The results and comparison are given.

For the service broker algorithm there are two main service broker policies in cloud analyst. In the Service proximity based routing service broker policy route the traffic to the closest data center that depends on network latency. In the Performance Optimized Routing policy the service brokers monitors the quickest data center based on response time. The function of service broker route the traffic to data center which have the minimum response time. The extended Performance Optimized Routing Policy service broker algorithm is the extension of performance optimized routing policy[5] by adding the third parameter is the current load and this algorithm also distribute the request of every user base by optimizing the performance. The extended Performance Optimized Routing Policy service broker algorithm uses the three parameters the first parameter is closest data center, the second parameter is the best configuration of the DC(data center) or the quickest DC(data center) and the third parameter is minimum load or traffic on the data center.

Initially a group of users generate the user requests with application-id, the request is immediately transferred with internet without delay. The internet decides with service broker for the allocation of available data center to user base. In proposed service broker policy initially traffic is allocated to closest Data center according to the network latency, In this policy the service broker continuously monitor the best response time, if it find quickest data center based on minimum response time then the user base requests are allocated between the closest data center and optimized data center. Now service broker also consider the third parameter that is the load or traffic on data center, the service broker also monitor the load or traffic on the available data centers, if the traffic or load of quickest data center is greater than the closest data center then the requests from user base is forwarded to closest data center otherwise the user base requests are assigned to quickest data center.

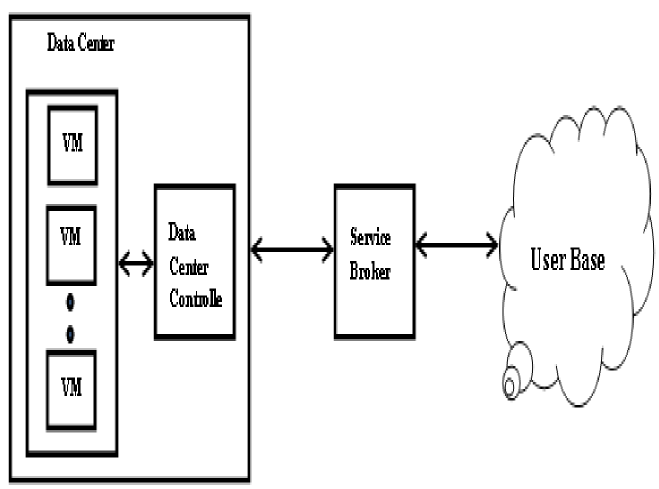

Figure: 2. Extended Performance Optimized Routing Policy

Priority = Location (Minimum Delay(α)) +Higher Configuration(β) + Current Load (γ)

Algorithm:

Step1: Maintain a list of all available Data Center by name and region.

Step 2: Initially the traffic is routed to Closest DC by using factor network latency.

Step 3: Continuously monitor the response time(RT) of Closest DC and Higher configurable Data Center or best response time DC, Allocate the requests of User Base among Best response time DC or closest DC.

Step 4: Now check the current load or traffic and allocate the requests of User Base among Best response time DC or closest DC.

```
if(latencies(QuickestDC)!=NULL)&&
(latencies(ClosestDC)!=NULL)
{
        if(traffic(QuickestDC)>traffic(ClosestDC))
        {
           dest=ClosestDC;
        }
        else
        {
           dest = QuickestDC;
           }
}
else
{
           dest=ClosestDC;
}
```

IV. SIMULATION AND RESULTS

For the simulation of Extended Performance Optimized Routing Policy service broker algorithm[5], a tool Cloud Analyst is used to evaluate the various load balancing parameters and the results are given one by one.

Simulation Configuration:

1. User base configuration:- In the following Table 1 we have selected a large scaled application data set, in that there are 6 user bases(UB1, UB2,….UB6) and 6 regions (0,1,2,…5) with some following default parameters.

Name	Region	Request /user/hour	Datasize/ Request (bytes)	Peak hours Start (GMT)	Peak hours End (GMT)	Avg. Peak Users	Avg. Off Peak Users
UB1	0	60	100	10	12	500000	50000
UB2	1	60	100	12	14	100000	10000
UB3	2	60	100	14	16	350000	35000
UB4	3	60	100	16	18	250000	25000
UB5	4	60	100	19	21	50000	5000
UB6	5	60	100	7	9	75000	7500

Table : 1. Userbase Configuration

Data Center Configuration:

Data center controller manages the data center management activities, the configuration of the various data center used in the simulation are given in table 2.

Name	Region	Arch	OS	VMM	Cost per VM $/Hr	Memory Cost $/s	Storage Cost $/s	Data Transfer Cost $/GB	Physical H/W Units
DC1	0	x86	Linux	Xen	0.1	0.05	0.1	0.1	20
DC2	1	x86	Linux	Xen	0.1	0.05	0.1	0.1	10
DC3	2	x86	Linux	Xen	0.1	0.05	0.1	0.1	1

Table: 2. Data Center Configuration

Other Configuration:

Other parameters are used in the simulation are given in table 3

Parameter	Value
User Grouping Factor in User base	1000
Request Grouping Factor in Data center	100
Executable instruction length /request	250 bytes
Load balancing Policy	Round Robin
Simulation Duration	60 Min.
Number of VM –	
• DC1	50
• DC2	25
• DC3	5
Data Center –	
• Memory per Machine	2048 MB
• No. of Processors	4
• VM Policy	Time Shared
VM -	
• Image Size	10000
• Memory	512
• Bandwidth	1000

Table: 3. Other Configuration

Scenario- For User Base Access mapping with multiple Data Centers

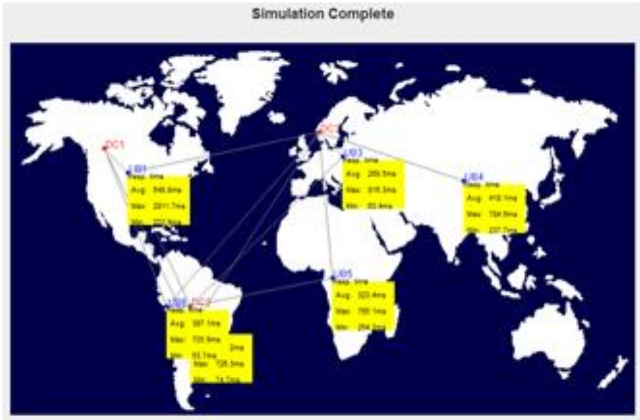

Figure: 3. Userbase access mapping with multiple Datacenters

User Base Response time:-

Response Time By Region

Userbase	Avg (ms)	Min (ms)	Max (ms)
UB1	648.767	202.935	2,811.742
UB2	412.177	74.73	726.272
UB3	268.504	63.394	816.308
UB4	418.072	237.681	784.617
UB5	323.383	254.319	765.145
UB6	397.109	53.671	705.863

Figure: 4. User Base Response Time

User Base Average Response Time(Hourly):-

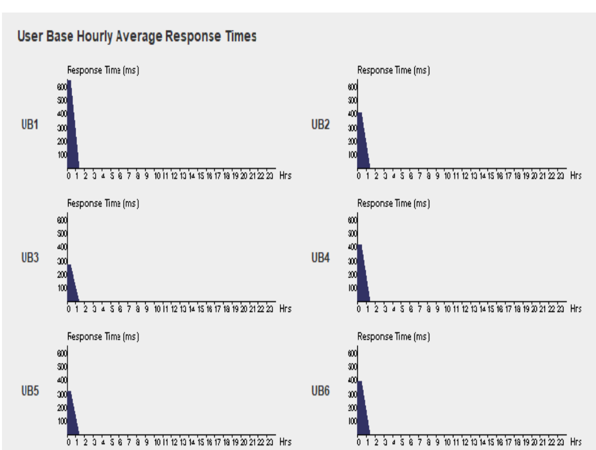

Figure: 5. User Base Average Response Time(Hourly)

Data Center Request Servicing Times and Average Processing Times (Hourly):-

Data Center Request Servicing Times

Data Center	Avg (ms)	Min (ms)	Max (ms)
DC1	2,072.845	125.631	2,757.692
DC2	314.894	6.586	645.695
DC3	171.868	0.887	458.209

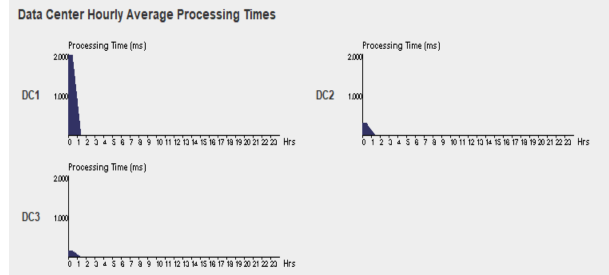

Figure: 6. Data Center Average Processing Time

Data Center Based Loading (Hourly) :-

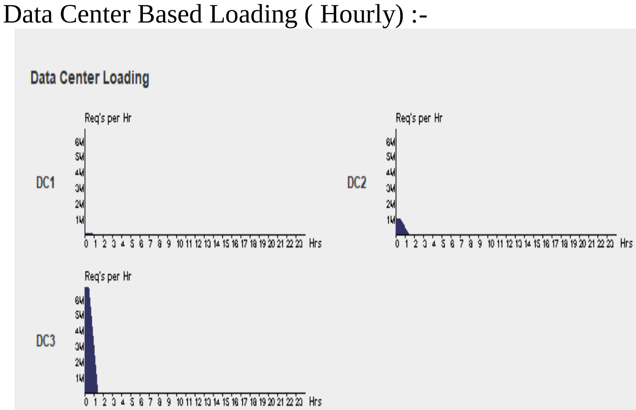

Figure: 7. Data Center Based Loading

Total VM and Data Transfer Cost:-

Cost

Total Virtual Machine Cost : $8.03

Total Data Transfer Cost : $76.35

Grand Total : $84.38

Data Center	VM Cost	Data Transfer Cost	Total
DC2	2.509	10.399	12.908
DC1	5.018	1.353	6.371
DC3	0.502	64.6	65.102

Figure: 8. Total VM and Data Transfer Cost

V. PERFORMANCE ANALYSIS

Here In the above simulation, The Extended Performance Optimized Routing Algorithm is simulated by taking the same Round Robin load balancing policy and compared with Service Proximity Based Routing and Performance Optimized Routing policies in terms of two major parameters Average

Response Time and Average Processing Time. From the Table and graph we observed that the Extended Performance Optimized Routing Algorithm gives the better average response time and Data Center Processing Time as compared Service Proximity Based Routing and Performance Optimized Routing algorithm.

Overall Response time:

Table: 4. Response Time

Service Broker Policy	Avg (ms)	Min (ms)	Max (ms)
Service Proximity Based Routing	1158.26	56.71	3314.06
Performance Optimized Routing	525.06	54.32	2809.83
Extended Performance Optimized Routing	461.18	53.67	2811.74

Data Center Processing Time:

Table: 5. Data Center Processing Time

Service Broker Policy	Avg (ms)	Min (ms)	Max (ms)
Service Proximity Based Routing	1049.96	2.04	3259.03
Performance Optimized Routing	379.69	1.57	2756.00
Extended Performance Optimized Routing	225.03	0.89	2757.69

Individual Data Center Processing Time:

Table: 6. Individual Processing Time

Service Broker Policy	Service Proximity Based Routing	Performance Optimized Routing	Extended Performance Optimized Routing
DC1 Processing Time (ms)	2540.98	1352.463	2072.845
DC2 Processing Time (ms)	87.119	137.869	314.894
DC3 Processing Time (ms)	155.947	148.87	171.868

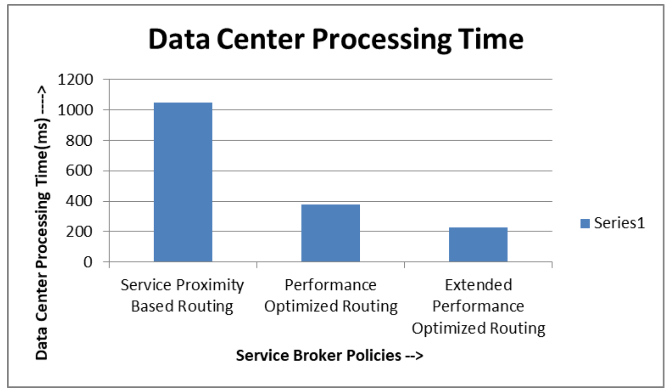

Figure: 10. Service Broker Policies V/S DC Processing Time

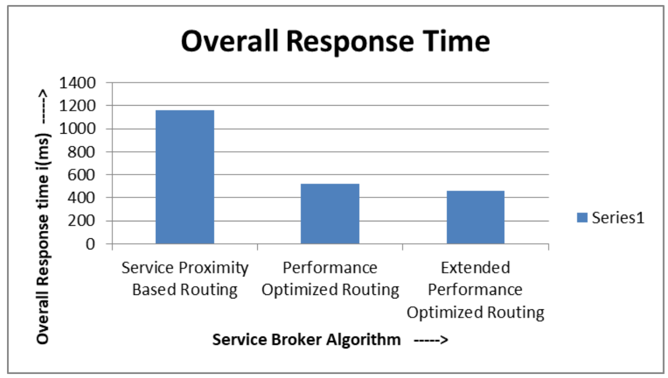

Figure: 11. Service Broker Policies V/S Response Time

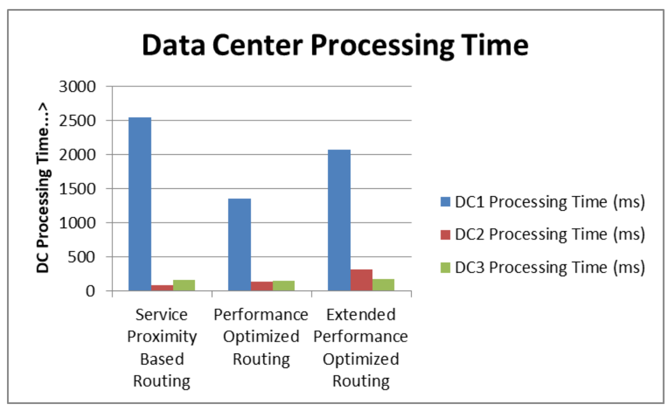

Figure: 12. Service Broker Policies V/S Individual DC Processing Time

VI. CONCLUSION

From all the simulation results, we can conclude that the Extended Performance Optimized Routing Algorithm works efficiently. It minimizes user base response time and request processing time of Datacentre. Here we simulate this by taking a large scale user base and if we use the Extended Performance Optimized Routing algorithm in our proposed framework for e–Governance using the federation of cloud that we discussed previously. It will distribute the loads among the clouds and will decreases the user response time and datacentre processing time. Hence the user will get quick, efficient services in reduced cost and provide the quality of services to the citizens.

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