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Analysis and Development of Load Balancing Framework for EyeOS

A.M. Gosai*, Rushi R. Raval**

Abstract

Cloud computing, is a growing concept for the internet based technologies which provides different kinds of services such as SAAS, MASS, PAAS, CAAS, IAAS, as pay per use concept. Cloud computing provide various deployment models such as public, private, and hybrid clouding. Today, many web based OS available such as Google Chrome OS, EyeOS. They provide services like as file, document and user management, end-users only required internet connection and browser as application. When number of user increased to access services provided by web based OS main questions arise on performance issues such as response time, data centre processing time, etc., Load balancing is a solution for performance. This is use for increase the performance of web based OS/applications. In this research paper we were do comparison of different web OS such as EyeOS, CorneliOS, and Lucid desktop and also done experiments and develop a load balancing framework for EyeOS.

Keywords: Web OS, Eye OS, Corneli OS, Cloud Analyst, Load Balancing, Service Breaker Policy

1. Overview of Cloud Computing

1.1 Cloud Computing

Cloud computing term is an internet based technology which provide pay per service and demand service like PAAS (Platform as a service), SAAS (Software as a service), MAAS (Monitoring as a service), CAAS (Communication as a service), and IAAS (Infrastructure as a service).

The characteristics of cloud computing are such as, on-demand self-service, Ubiquities network access, Rapid elasticity, location independent resource pooling, pay per use.

1.2 Cloud Computing Models

- Private / internal cloud: cloud services are provided solely for an organization and are managed by organization or a third party.
- Public or external cloud: cloud services are available to the public, and own by an organization selling cloud services, for ex., Amazon EC2, Google App Engine, Window Azure.
- Hybrid cloud: An integrated cloud services arrangement that includes a cloud model and something else, e.g., data stored in private cloud or agency database is manipulated by a program running in the public cloud.

1.3 Cloud Computing Services

There are following type of models available for cloud computing.

- Cloud software as a service: SAAS is a model or phase where, Software Companies provides maintenance as a service. Daily technical operations and support for the software provided to client by the particular vendor. Cloud computing makes the availability of software-as-a-service to it the end user. These services are provided through internet basis. He / She will pay only for what he / she used. In SAAS user will only requesting of particular software and vendor will provide the services to that

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user. End users need not to bother about the license and other software related complexity and issues.

- Cloud platform as a service: PAAS is most like S.A.A.S and it is a delivery based model or phase which is delivered computing platform as a service over the internet basis. Furthermore we can say it is software which provides it as service that can be used to build higher-level services and applications. P.A.A.S provides platform or you can say development environment that users can access and utilize on the internet. Platform Services are provided through the browser usage.
- Cloud infrastructure as a service: Infrastructure-as-a-Service (IAAS) is the delivery of computer infrastructure (typically a platform virtualization environment) as a service.
- Cloud communication as a service: Cloud Communication as a Service is responsible managing hardware and software for communication technology. Communication technology likes Voice over IP service (VoIP), Video conferencing and instant messaging (IM). Cloud Communication as a Service is used in telecommunications industry.
- Cloud monitoring as a service: Cloud Monitoring as a Service is responsible for protecting a client from cyber threats. Cloud monitoring as a Service use for securing and maintaining the integrity, confidentiality, and availability of IT assets. Cloud monitoring as a Service provide real-time, 24/7 monitoring and protecting critical information assets of their customers.
- Cloud database as a service: Cloud Database as a Service provide different type of database services to the customer.

2. Web Based O/S

2.1 Overview of Web Based O/S

Web Operating System also known as Web OS [1]. Web Operating System is a web based. User use Web Operating System via intranet or internet. Web Operating System provides functionality similar to tradition window based operation system such as file management, user management, n/w management, desktop management, etc.

2.2 Following, are The List of Web OS

- EyeOS
- Cornelios
- Lucid desktop
- iSpaces
- Cloudo
- Jolicloud
- Glide

2.3 Overview of EyeOS

EyeOS is free web based operating system. EyeOS is release under the AGPLv3 license. EyeOS is available private as well as public cloud, EyeOS provide feature such as file management, user management, similar to desktop operating system. EyeOS allow users to online access of office documents, calendar, contacts anywhere, and anytime [2]

K. Deepa gives brief explanation of cloud computing and how cloud computing is use to deploy B2B applications deploy and access in cloud computing using EyeOS. Cloud Analyst and load balancing algorithm [3]

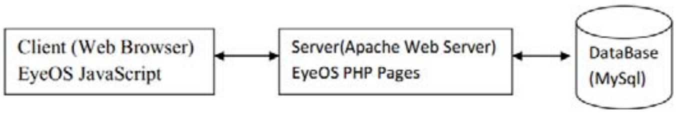
EyeOS allowing collaborative work and multiple user can work on same document like single place. User can access and use EyeOS from PC (Personal Computer), laptops, a mobile gadget anywhere and anytime in the world.

EyeOS is available with toolkit. User can use toolkit to build customize application for EyeOS as per user need. EyeOS also provide mobile support so that user can access EyeOS through their mobile phone through internet connection based on URL such as http://xxx/yoururl.xxx/EyeOS/mobile. User can upload photos from their mobile to EyeOS and also do many things. [4]

2.4 System Structure

EyeOS System Structure is divided in three components such as Client, Web Server, and Database Server. On client side JavaScript is use for GUI creation such menu, textbox etc. on Web Server side apache web server is use. All PHP files are deployed in web server. User make request from client side with web browser. Request sends to the web server. Web server process request and generate output. Generated output sends to the web browser. And client gets the result. Database Server use to storing the data. EyeOS use MySQL Database Server.

Figure 1: EyeOS System Structure



2.5 Services of EyeOS

- Free and Open Source: EyeOS is a licensing free open source s/w under the GPL (General Public License). EyeOS is an open source. User can make change in source code.
- File management: File management service of EyeOS enable user to create, delete, update file and folder. It provides functionality for uploading files to the server as well.
- User management: User management services provides functionality such as user account creation, deletion, updating, gives access rights such as read, writes etc.
- Customize application development support: EyeOS allow user to create customize application.
- Office support: Office provides service such as Word Processor, Spreadsheets, and Presentations. It provides Support for MS Office and Open Document files.
- Network supporting service: Network provides network services such as Internal Messaging System, Bulletin Board, Proxies FTP Client, RSS Feeds Reader.
- Desktop Management: Desktop provides service for Desktop management such as Third-party applications; Auto-run desired apps, Translations, Theming.
- Mobile support: EyeOS support mobile devices also. User can access EyeOS from mobile anywhere and anytime through internet.

2.6 System Requirements

Table 1: Eye OS System Requirement

Server side	
List of operating systems supported	Mac, Microsoft Windows platform, Linux/Unix
Web server	Apache web server
Scripting language	Php5
Database servers	MySQL
Server side	
Other s/w	EyeOS
Client side	
Web browser	Firefox Internet explorer 6 Safari Google chrome Opera

2.7 Comparison of Eye OS, Corneli OS, Lucid Desktop

Table 2: Comparison of Web Operating Systems

Operating System	*EyeOS*	*CorneliOS*	*Lucid Desktop*
Microsoft supported Windows OS	√	√	√
Mac	√	√	√
Linux	√	√	√
Unix	√	√	√
Script Language			
Php5	√	√	√
JavaScript	√	√	√
Perl/CGI	√	√	√
Database Server			
MySQL	√	√	√
pgSQL	√	√	√
SQLite	√	√	√
Domain services			
Free and open source	√	√	√
File management	√	√	√
User management	√	√	√
Office support	√	√	√
Customize application development support	√	√	√
Networking supporting services	√	√	√
Desktop management	√	√	√
Mobile support	√	√	√
CMS	√	√	√
DB management	√	√	×
Multiple language support	×	√	√
Backup support	×	√	×
Web based 3D environment	×	√	×
Load balancing support	×	×	×

Meaning of symbol,

- √ Indicate that supported by web os
- √ Indicate that not supported by web os

3. Overview of Load Balancing

Load balancing is use to distributes the workload across multiple server. Load balancing is used to improve user fulfilment and resource utilization. Load balancing take care no server will overload or no server will ideal. Load balancing help user to fully utilizing the available resources.

Load balancing is a process to improve performance of a system. Load balancing improve overall response time, response time by region. Load balancing increase data center request servicing times, cost, data center processing time.

3.1 Static Load Balancing

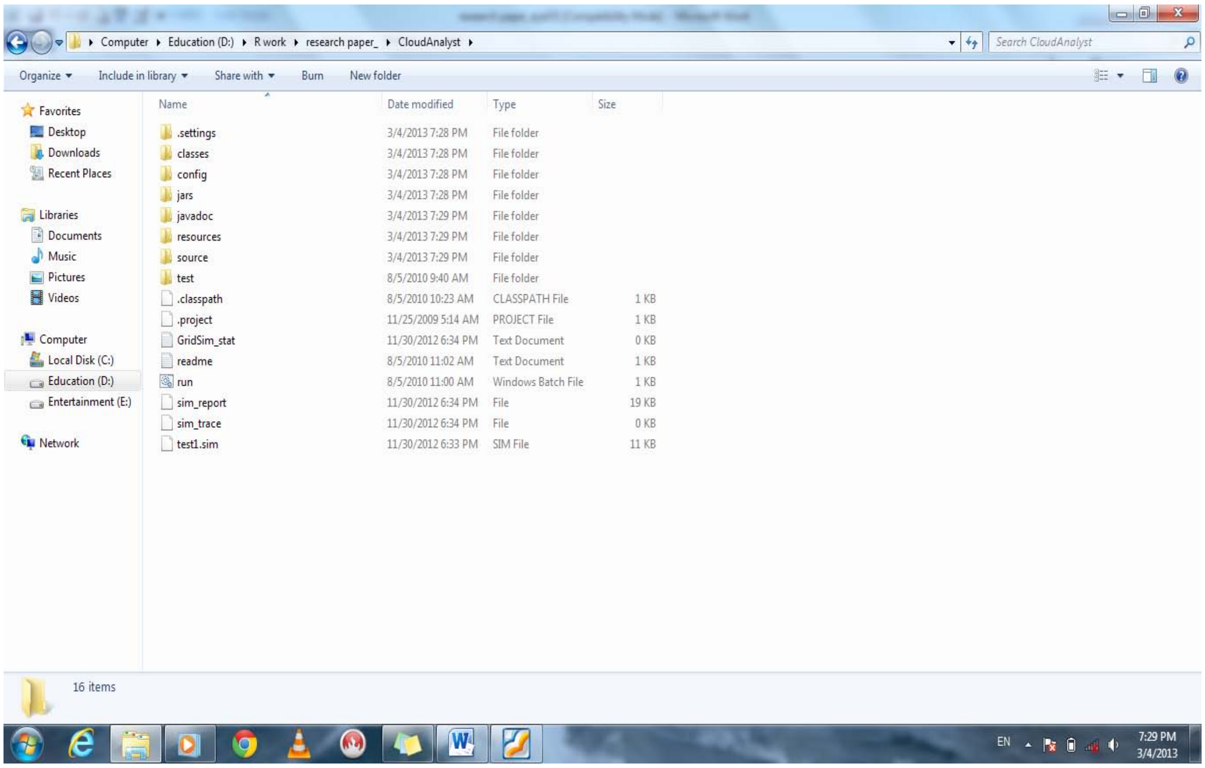
In Static load balancing algorithm all the system related detail like performance of the processors already known by the end user.[5][6] Depending of available performance information work load will distribute across the all computers. In static load balancing two processors are used one is master and second is slave. Master processor is use to distribute workload across the entire slave processor. Then slave processor do processing based on given workload and after processing prepares result and result is submitted back to the main master processor. Static algorithm decreases the overall execution time. Static algorithm is not use when performance requirement dynamically change at run time.

4. Cloud Analyst

Bhathiya developed Cloud Analyst simulation tool based on CloudSim. Cloud Analyst is used to studying behavior of application deployment under various deployment Configurations [5].

Ajith Singh. N and M. Hemalatha discuss three simulator based on High performance computing network. GridSim for Grid Computing, CloudSim for Cloud Computing and Cloud Analyst for cloud environment cost wise. They set different Configuration parameter of Cloud Analyst such as User bases and Datacenter for the how many cost for if user will deploy application in cloud computing environment.[3]

Figure 2: Folder Structure



Manisha Malhotra use Cloud Analyst tool to Configuration User bases and Data Center parameter for optimization of application performance and response time on same cost.[7]

Cloud analyst is a simulation tool developed by Cloud Computing and Distributed Systems (CLOUDS) Laboratory at Australia. Cloud analyst is built on top of Cloudsim. Cloud analyst includes all functionality of cloudsim. Cloudsim is a modeling and simulation tool. Cloudsim use for modeling and simulation of data centers, Virtual machines with customized parameter.

Cloud Analyst, is use for simulation of different web based application(s) according to different configuration simulation parameter such as User bases, Application Deployment, Data Centers, Physical Hardware Details of Data Center : DC1, Advanced Configuration Simulation.

4.1 Installation Steps of Cloud Analyst

1. Download cloud analyst from following link: http://www.cloudbus..org/cloudsim/cloudanalyst.zip
2. Copy file for any location in system.
3. Extract the downloaded cloudanalyst.zip to particular folder. E.g., cloud analyst
4. User will find following folder structure.
5. Double click on run run icon to run cloud analyst.
6. Command prompt will open in background.
7. Cloud analyst provides GUI to the user.
8. User can set different simulation parameter according different scenario.
9. Configuration Simulation is use for Configuration simulations such as main Configuration, data center Configuration, advanced simulation.
10. Define internet characteristics is use for Configuration different internet characteristics such as remission delay in milliseconds and bandwidth in mbps.
11. Run simulation is use for running simulation. It will generate output.
12. Exit is use for close the simulation.
13. Show region boundaries is use for display region boundaries.

4.2 Cloud Analyst Load Balancing Algorithm

Cloud analyst support following load balancing algorithm to distributed workload across multiple machines as well.

- Round robin algorithm
- Throttled load balancing algorithm
- Equally spread current execution algoritham

Figure 3: Command Prompt

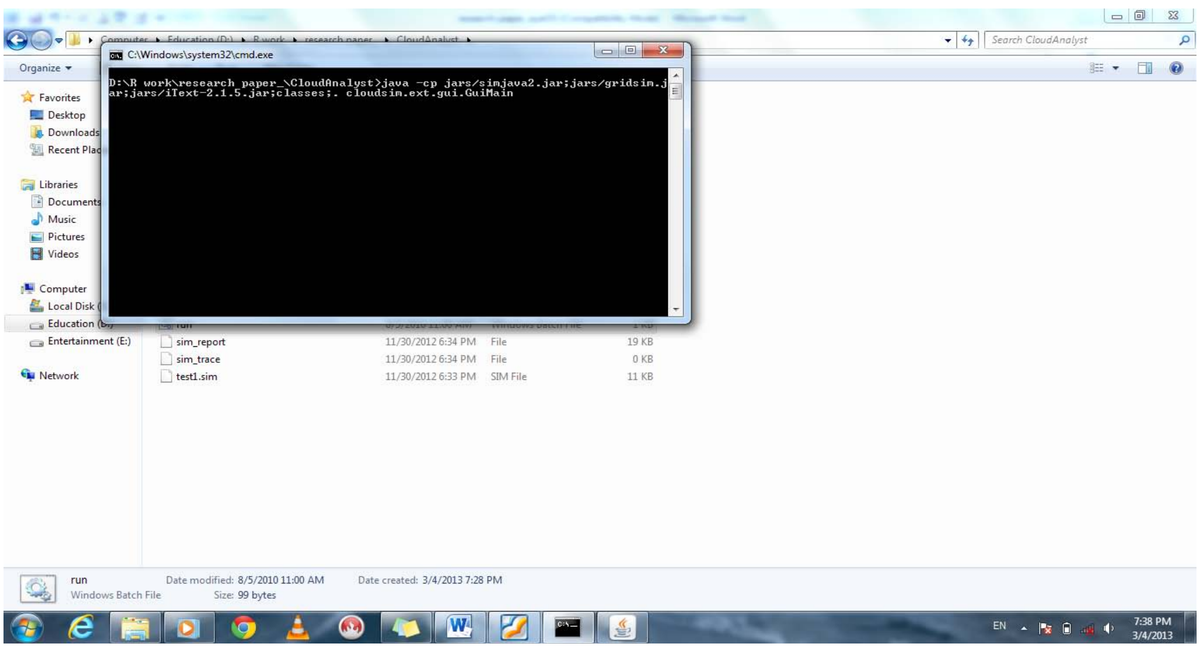


Figure 4: Cloud Analyst GUI

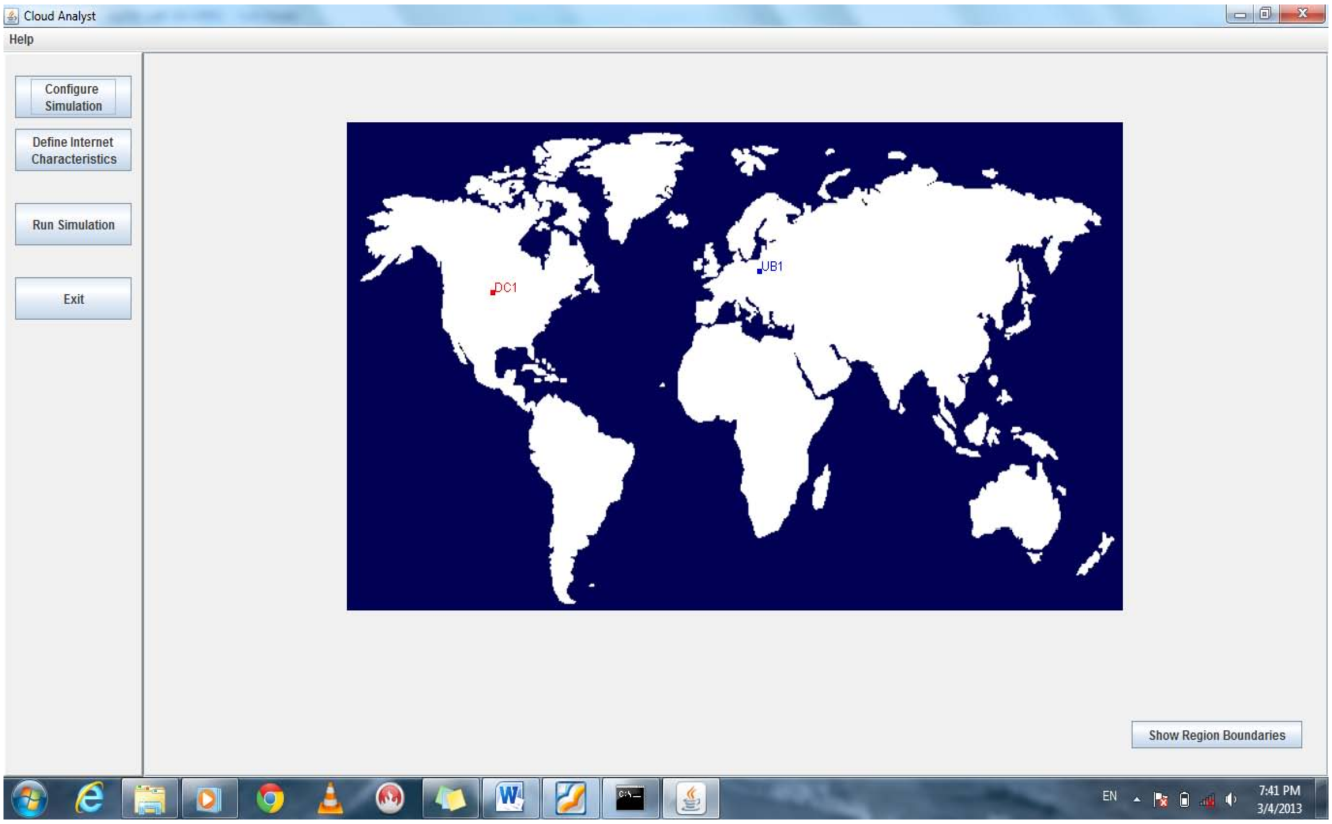
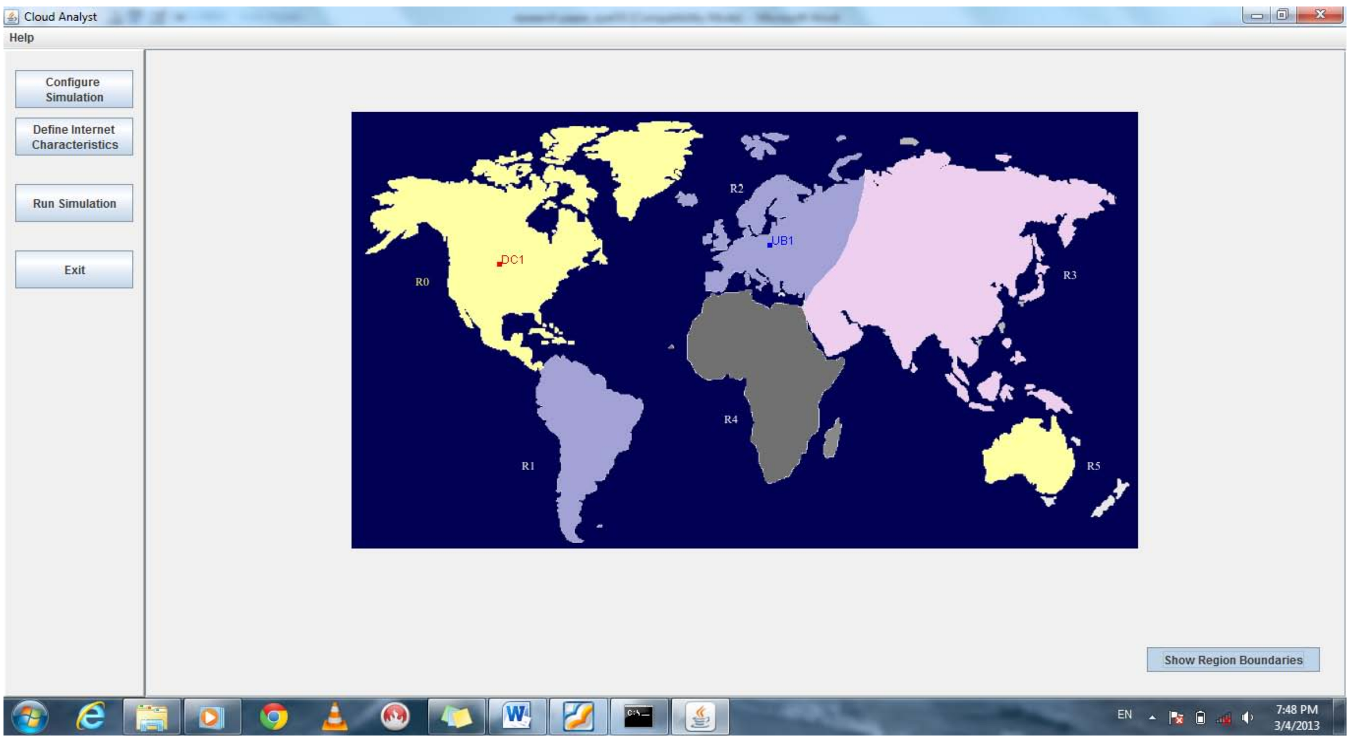


Figure 5: Region Boundries of Cloud Analyst



4.3 Cloud Analyst Service Broker Policy

Cloud analyst support following cloud analyst service

broker policy.

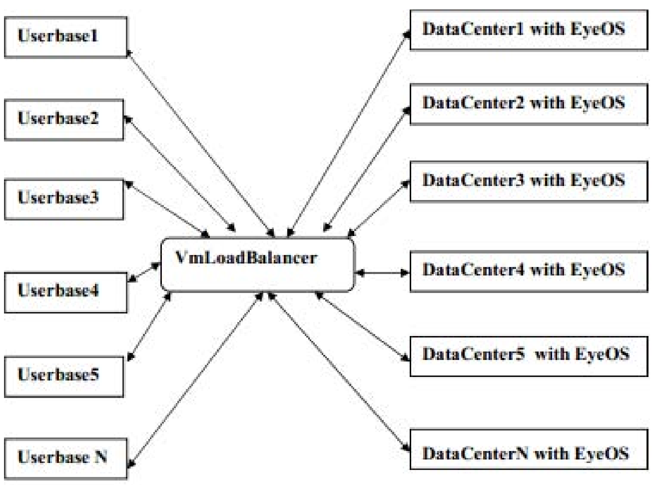
- Closet data center
- Optimise response time
- ReConfiguration dynamically with load

Depending upon user requirement policy will be set.

5. Development of Load Balancing Framework for EyeOS

5.1 Development of Load Balancing Framework for EyeOS

Figure 6: Development of Load Balancing Framework for EyeOS



5.2 Introduction to Load Balancing Framework for EyeOS

User base: A user base is use to access EyeOS application deployed in datacenters. User base is responsible to generate traffic. User base is considerable as single unit. Into a single unit user base might be 1 user or hundred user or even thousand users is created for generating traffics. User base is created user as per user requirement.

Vm Load Balancer: When user base generate request and sent it. Request is first sent to the VmLoadBalancer. VmLoadBalancer responsible to allocate the load to the available various data centers. VmLoadBalancer allocate the load to the data center based on differ load balancing policy. Policy's like as round robin algorithm, equally spread current execution load algorithm, and throttled algorithm.

Data Center: Data center is a place where EyeOS web based O.S. deployed. Cloud Application Service Broker is responsible to decide which data center should accept and process requests coming from each user base. And give services to the particular user bases.

Cloud analyst enable user how to optimize performance of application, how to distribute application in different data center in different region with different type of load balancing technique.

ESCE scheduling algorithm good compare to with the round robin scheduling to estimate response time, processing time, which is having an impact on cost. Equal Spread Current Execution Load algorithm reduced cost in data transfer and virtual machine formation by dynamically allocates the resources to the job in queue leading. ESCE algorithms improved job scheduling and resource allocation. [8]

Ms. NITIKA, Ms. SHAVETA and Mr. GAURAV RAJ do comparative study of service broker policy and give suggestion that virtual machine cost and data transfer time in the ESCE and throttled algorithm is much better when compared to round-robin algorithms[9].

5.3 Need for Load Balancing Framework for EyeOS

- To Reducing Energy Consumption
- To Performance improvement
- To handle Fault tolerance
- To Increase Overall Response time
- To Increase Response Time by Region
- To fully utilization of available resources such as processor, virtual machine, etc.
- To Reduce Cost

6. Experiments and Results

To analyze load balancing in EyeOS researcher set common Configuration for various component of the cloud analyst. Researcher set the different five user bases parameter located in different region. Researcher set Simulation Duration Configuration Parameter as shown in Table 3.1, User Bases Parameter as shown in Table 3.2, Physical Hardware Details of Data Center: DC1 parameter as shown in Table 3.3 Advanced Configuration Simulation Parameter as shown in Table 3.4, Configuration Internet Characteristics Parameter such as Delay Matrix parameter as shown in Table 3.5, Bandwidth Matrix Parameter as shown in Table 3.6.

Table 3.1: Simulation Duration Configuration Parameter [10]

Simulation Duration	*Value*
Min	60

Table 3.2: User bases Configuration Parameter [10]

Name	*Region*	*Request Per hour*	*Data size per request(bytes)*	*Peak hours Start(GMT)*	*Peak hours End(GMT)*	*Avg peak users*	*Avg off-peak user*
UB1	0	10	1000	3	9	1000	1000
UB2	1	20	1000	3	9	2000	2000
UB3	2	6	1000	3	9	3000	3000
UB4	3	3	1000	3	9	4000	4000
UB5	4	60	1000	3	9	5000	5000

Table 3.3: Physical H/W Details of Data Center: DC1 Configuration Parameter [10]

Id	*Memory(Mb)*	*Storage(Mb)*	*Available BW*	*No. of processors*	*Processor speed*	*VM policy*
0	204800	100000000	1000000	4	10000	TIME_SHARED
1	204800	100000000	1000000	4	10000	TIME_SHARED

Table 3.4: Advanced Simulation Configuration Parameter[10]

User grouping factor in User Bases: (Equivalent to number of simultaneous users to from a single user base)	*Request grouping factor in data centers (equivalent to number of simultaneous request a single application instance can support)*	*Executable instruction length per request: (bytes)*	*Load balancing policy across VM's in a single data center*
10	10	100	Round Robin

Table 3.5: Delay matrix Configuration Parameter [10]

Region/ Region	*0*	*1*	*2*	*3*	*4*	*5*
0	25	100	150	250	250	100
1	100	25	250	500	350	200
2	150	250	25	150	150	200
3	250	500	150	25	500	500
4	250	350	150	500	25	500
5	100	200	200	500	500	25

Table 3.6: Bandwidth matrix Configuration Parameter [10]

Region/ Region	*0*	*1*	*2*	*3*	*4*	*5*
0	2000	1000	1000	1000	1000	1000
1	1000	800	1000	1000	1000	1000
2	1000	1000	2500	1000	1000	1000
3	1000	1000	1000	1500	1000	1000
4	1000	1000	1000	1000	500	1000
5	1000	1000	1000	1000	1000	2000

6.1 Test 1 – EyeOS Hosted on A Single Data Center

To analyze load balancing for EyeOS Researcher set user bases Configuration parameter, service broker policy set closest data center and load balancing algorithm set round robin as shown in Table 3.7. EyeOS hosted on a 1 data center DC1 located at region 0, as shown in Table 3.9. After set all Configuration parameter perform simulation and calculate overall response time summary, Response Time by Region, Data Center Request Servicing Times, and Cost.

Table 3.7: Test 1 Configuration Parameter [10]

Test 1	
Test parameter	*Value*
User base	UB1, UB2, UB3, UB4, UB5
Data center	DC1
Data center region	0
Service broker policy	Closet data center
Load balancing algorithm	Round Robin

Table 3.8: Test 1 Application Deployment Parameter [10]

Service broker policy	*Data center*	*#Vms*	*Image size*	*Memory*	*BW*
Closet data center	DC1	5	10000	512	1000

Table 3.9: Test 1 Data Centers Configuration Parameter [10]

Name	DC1
Region	0
Arch	X86
OS	Linux
VMM	Xen
Cost per VM $/Hr	0.1
Memory cost $/s	0.05
Storage cost $/s	0.1
Data transfer cost $/Gb	0.1
Physical H/w units	2

6.2 Test 1 – Result

Table 3.10: Test 1 Result Overall Response Time Summary [10]

Overall response time summary			
	Avg(ms)	*Min(ms)*	*Max(ms)*
Overall response time	452.31	41.07	655.89
Data center processing time	0.59	0.09	1.24

Figure 3.1: Test 1 Result Overall Response Time Summary

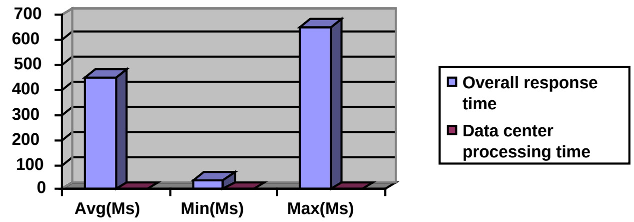


Table 3.11: Test 1 Result Response Time by Region [10]

Response time by region			
User base	*Avg (ms)*	*Min (ms)*	*Max (ms)*
UB1	50.97	41.07	63.50
UB2	202.81	155.35	257.56
UB3	303.97	238.03	368.17
UB4	506.43	374.83	630.87
UB5	507.44	372.80	655.89
Overall response time by region	314.324	41.07	655.89

Figure 3.2: Test 1 Response Time by Region

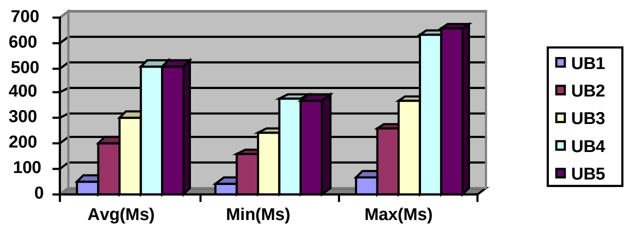


Table 3.12: Test1 Result Data Center Request Servicing Times [10]

Data center request servicing times			
Data center	*Avg(Ms)*	*Min(Ms)*	*Max(Ms)*
DC1	0.59	0.09	1.24
Over all data center request servicing times	0.59	0.09	1.24

Figure 3.3: Test 1 Data Center Request Servicing Times

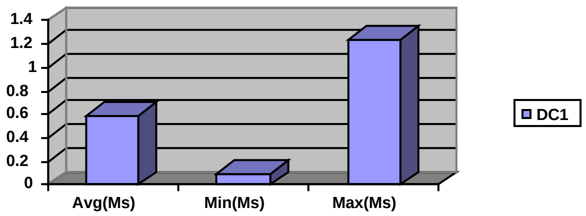
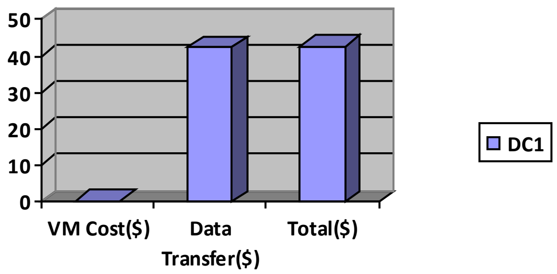


Table 3.13: Test 1 Result Cost [10]

Data center	VM Cost($)	Data transfer cost($)	Total($)
DC1	0.50	42.23	42.73
Total cost	0.50	42.23	42.73

Figure 3.4: Test 1 Result Cost



6.3 Test 2 - EyeOS Hosted on A Two Data Center

To analyze load balancing for EyeOS Researcher set User Bases Configuration parameter, Service Broker Policy set Closest Data Center and Load Balancing Algorithm set Round Robin as shown in Table 3.14. Add one more Data Center. Now EyeOS hosted on a two Data Center DC1 and DC2 located at region0, region1 respectively as shown in Table 3.16. After set all Configuration parameter perform simulation and calculate Overall Response Time Summary, Response Time by Region, Data Center Request Servicing Times, and Cost.

Table 3.14: Test 2 Configuration parameter [10]

Test 2	
Test parameter	Value
User base	UB1, UB2, UB3, UB4, UB5
Data center	DC1, DC2
Data center region	0, 1
Service broker policy	Closet data center
Load balancing algorithm	Round Robin

Table 3.15: Test 2 Application Deployment Parameter [10]

Service broker policy	Data center	#Vms	Image size	Memory	BW
Closet data center	DC1	5	10000	512	1000
	DC2	5	10000	512	1000

Table 3.16: Test 2 Data Centers Configuration Parameter [10]

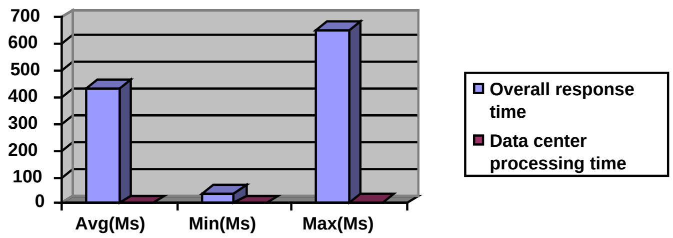
Name	DC1	DC2
Region	0	1
Arch	X86	X86
OS	Linux	Linux
VMM	Xen	Xen
Cost per VM $/Hr	0.1	0.1
Memory cost $/s	0.05	0.05
Storage cost $/s	0.1	0.1
Data transfer cost $/Gb	0.1	0.1
Physical H/w units	2	2

6.4 Test 2 – Result

Table 3.17: Test 2 Result Overall Response Time Summary [10]

Overall response time summary			
	Avg(ms)	Min(ms)	Max(ms)
Overall response time	436.58	41.21	656.04
Data center processing time	0.74	0.12	1.94

Figure 3.5: Test 2 Result Overall Response Time Summary



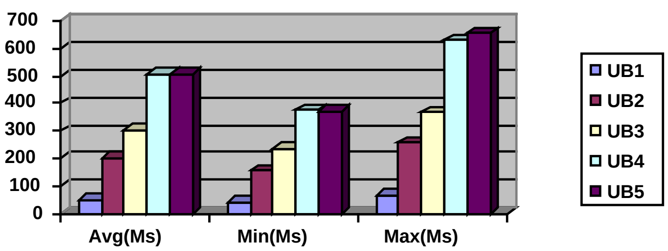
After performing the simulation the overall response time decrease in result of test 2 compare to test 1 result computed by Cloud analyst as shown in table 3.17 and figure 3.5.

After performing the simulation data center processing time increase in result of test 2 compare to test 1 result computed by Cloud analyst as shown in table 3.17 and figure 3.5.

Table 3.18: Test 2 Result Response Time by Region [10]

Response time by region			
User base	Avg(Ms)	Min(Ms)	Max(Ms)
UB1	50.94	41.07	63.50
UB2	202.80	155.35	257.56
UB3	304.19	236.14	368.17
UB4	506.28	374.83	630.87
UB5	507.44	372.80	655.89
Overall response time by region	314.33	41.07	655.89

Figure 3.6: Test 2 Response Time by Region

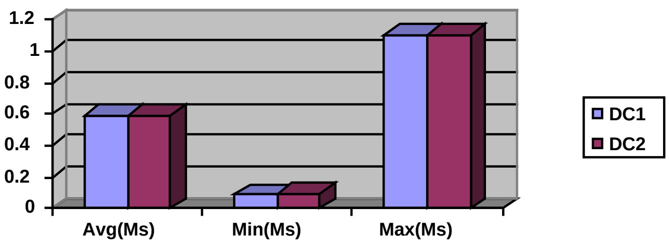


After performing the simulation the response time by region decrease in result of test 2 compare to test 1 result computed by cloud analyst as shown in table 3.18 and figure 3.6

Table 3.19: Test2 Result Data Center Request Servicing Times [10]

Data center request servicing times			
Data center	Avg(Ms)	Min(Ms)	Max(Ms)
DC1	0.59	0.09	1.10
DC2	0.59	0.10	1.10
Over all data center request servicing times	0.59	0.09	1.10

Figure 3.7: Test 2 Data Center Request Servicing Times

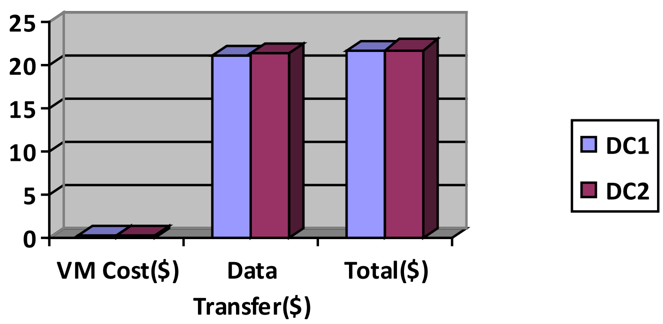


After performing the simulation the data center request servicing times by region increase in result of test2 compare to test1 result computed by cloud analyst as shown in table 3.19 and figure 3.7

Table 3.20: Test 2 Result Cost [10]

Data center	VM Cost($)	Data transfer cost($)	Total($)
DC1	0.50	21.03	21.54
DC2	0.50	21.20	21.70
Total cost	1.00	42.23	43.24

Figure 3.8: Test 2 Result Cost



After performing the simulation the total cost increase in result of test2 compare to test1 result computed by cloud analyst as shown in table 3.20 and figure 3.8.

6.5 Test 3 - EyeOS Hosted on A Three Data Center

To analyze load balancing for EyeOS Researcher set User Bases Configuration parameter, Service Broker Policy set Closest Data Center and Load Balancing Algorithm set Round Robin as shown in Table 3.21. Add one more Data Center. Now EyeOS hosted on a three Data Center DC1, DC2 and DC3 located at region0, region1 and region2 respectively as shown in Table 3.23. After

Table 3.21: Test 3 Configuration Parameter [10]

Test 3	
Test parameter	Value
User base	UB1, UB2, UB3, UB4, UB5
Data center	DC1, DC2, DC3
Data center region	0, 1, 2
Service broker policy	Closet data center
Load balancing algorithm	Round Robin

set all Configuration parameter perform simulation and calculate Overall Response Time Summary, Response Time by Region, Data Center Request Servicing Times, and Cost.

Table 3.22: Test 3 Application Deployment Parameter [10]

Service broker policy	*Data center*	*#Vms*	*Image size*	*Memory*	*BW*
Closet data center	DC1	5	10000	512	1000
	DC2	5	10000	512	1000
	DC3	5	10000	512	1000

Table 3.23: Test 3 Data Centers Configuration Parameter [10]

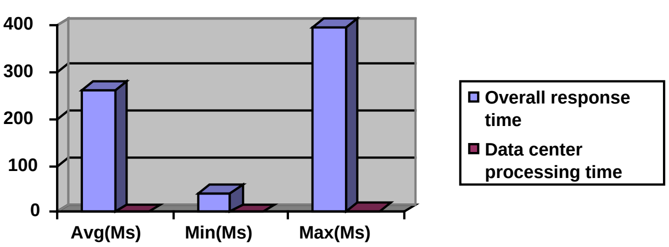
Name	DC1	DC2	DC3
Region	0	1	2
Arch	X86	X86	X86
OS	Linux	Linux	Linux
VMM	Xen	Xen	Xen
Cost per VM $/Hr	0.1	0.1	0.1
Memory cost $/s	0.05	0.05	0.05
Storage cost $/s	0.1	0.1	0.1
Data transfer cost $/Gb	0.1	0.1	0.1
Physical H/w units	2	2	2

6.6 Test 3 – Result

Table 3.24: Test 3 Result Overall Response Time Summary [10]

Overall response time summary			
	Avg(ms)	*Min(ms)*	*Max(ms)*
Overall response time	260.71	40.70	396.35
Data center processing time	0.66	0.12	3.23

Figure 3.9: Test 3 Result Overall Response Time Summary



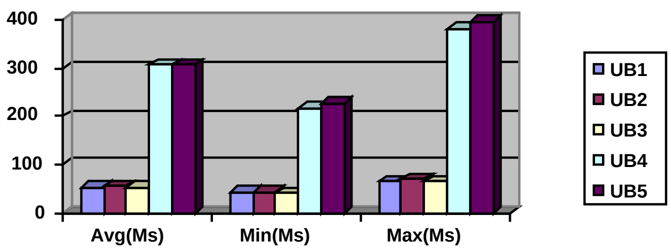
After performing the simulation the overall response time decrease in result of test 3 compare to test2 and test1 result computed by Cloud analyst as shown in table 3.24 and figure 3.9.

After performing the simulation data center processing time increase in result of test3 compare to test2 and test1 result computed by Cloud analyst as shown in table 3.24 and figure 3.9.

Table 3.25: Test3 Result Response Time by Region [10]

Response time by region			
User base	*Avg(Ms)*	*Min(Ms)*	*Max(Ms)*
UB1	51.14	41.21	63.65
UB2	53.82	41.39	67.95
UB3	52.11	40.70	63.56
UB4	306.28	217.73	381.62
UB5	307.45	225.83	396.35
Overall response time by region	154.16	40.7	396.35

Figure 3.10: Test3 Response Time by Region

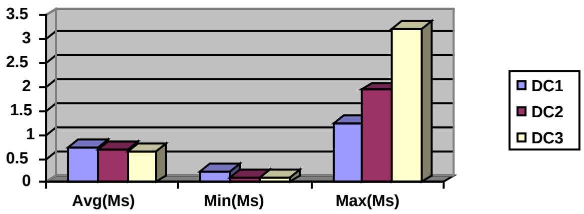


After performing the simulation the response time by region decrease in result of test3 compare to test2 and test1 result computed by cloud analyst as shown in table 3.25 and figure 3.10.

Table 3.26: Test3 Result Data Center Request Servicing Times [10]

Data center request servicing times			
Data center	*Avg(Ms)*	*Min(Ms)*	*Max(Ms)*
DC1	0.74	0.24	1.25
DC2	0.70	0.12	1.94
DC3	0.65	0.12	3.23
Over all data center request servicing times	0.697	0.12	3.23

Figure 3.11: Test3 Data Center Request Servicing Times

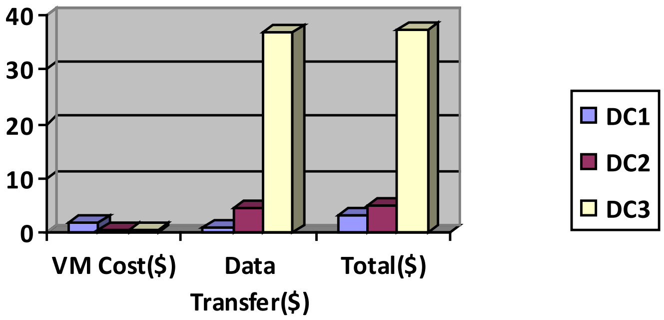


After performing the simulation the data center request servicing times by region increase in result of test3 compare to test2 and test1 result computed by cloud analyst as shown in table 3.26 and figure 3.11.

Table 3.27: Test3 Result Cost [10]

Data center	*VM Cost($)*	*Data transfer cost($)*	*Total($)*
DC1	2.01	1.17	3.18
DC2	0.50	4.49	4.99
DC3	0.50	36.57	37.07
Total cost	3.01	42.23	45.24

Figure 3.12: Test3 Result Cost



After performing the simulation the total cost increase in result of test3 compare to test2 and test1 result computed by cloud analyst as shown in table 3.27 and figure 3.12.

6.7 Test 4 - EyeOS Hosted on A Four Data Center

To analyze load balancing for EyeOS Researcher set User Bases Configuration parameter, Service Broker Policy set Closest Data Center and Load Balancing Algorithm set Round Robin as shown in Table 3.28. Add one more Data Center. Now EyeOS hosted on a four Data Center DC1, DC2, DC3 and DC4 located at region0, region1, region2 and region3 respectively as shown in Table 3.30. After set all Configuration parameter perform simulation and calculate Overall Response Time Summary, Response Time by Region, Data Center Request Servicing Times, and Cost.

Table 3.28: Test4 Configuration Parameter [10]

Test 4	
Test parameter	*Value*
User base	UB1, UB2, UB3, UB4, UB5
Data center	DC1, DC2, DC3, DC4
Data center region	0, 1, 2, 3
Service broker policy	Closet data center
Load balancing algorithm	Round Robin

Table 3.29: Test4 Application Deployment Parameter [10]

Service broker policy	*Data center*	*#Vms*	*Image size*	*Memory*	*BW*
Closet data center	DC1	5	10000	512	1000
	DC2	5	10000	512	1000
	DC3	5	10000	512	1000
	DC4	5	10000	512	1000

Table 3.30: Test4 Data Centers Configuration Parameter [10]

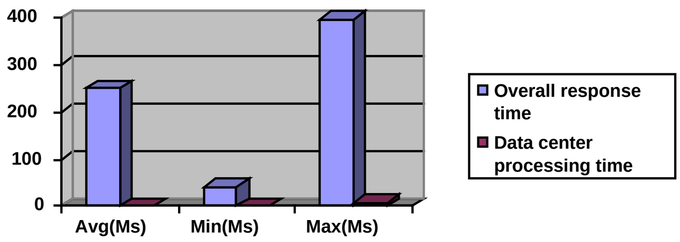
Name	DC1	DC2	DC3	DC4
Region	0	1	2	2
Arch	X86	X86	X86	X86
OS	Linux	Linux	Linux	Linux
VMM	Xen	Xen	Xen	Xen
Cost per VM $/Hr	0.1	0.1	0.1	0.1
Memory cost $/s	0.05	0.05	0.05	0.05
Storage cost $/s	0.1	0.1	0.1	0.1
Data transfer cost $/Gb	0.1	0.1	0.1	0.1
Physical H/w units	2	2	2	2

6.8 Test 4 – Result

Table 3.31: Test4 Result Overall Response Time Summary [10]

Overall response time summary			
	Avg(ms)	*Min(ms)*	*Max(ms)*
Overall response time	250.36	40.01	396.35
Data center processing time	0.74	0.12	6.92

Figure 3.13: Test 4 Result Overall Response Time Summary



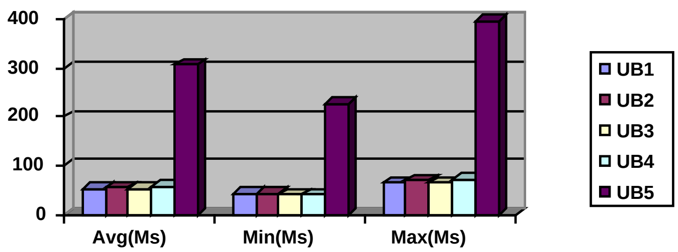
After performing the simulation the overall response time decrease in result of test 4 compare to test3, test2 and test1 result computed by Cloud analyst as shown in table 3.31 and figure 3.13.

After performing the simulation data center processing time increase in result of test4 compare to test3, test2 and test1 result computed by Cloud analyst as shown in table 3.31 and figure 3.13.

Table 3.32: Test4 Result Response Time by Region [10]

Response time by region			
User base	*Avg(Ms)*	*Min(Ms)*	*Max(Ms)*
UB1	51.09	41.21	63.65
UB2	53.81	41.39	67.95
UB3	52.10	40.70	64.13
UB4	55.65	40.01	70.83
UB5	307.45	225.83	396.35
Overall response time by region	104.02	40.01	396.35

Figure 3.14: Test4 Response Time by Region

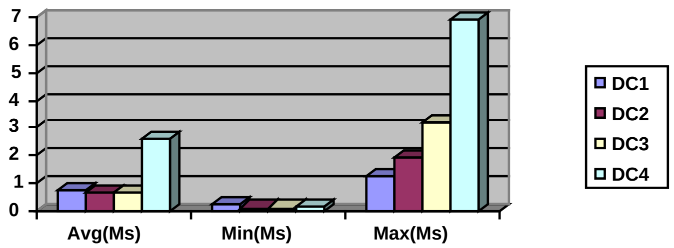


After performing the simulation the response time by region decrease in result of test4 compare to test3, test2 and test1 result computed by cloud analyst as shown in table 3.32 and figure 3.14.

Table 3.33: Test4 Result Data Center Request Servicing Times [10]

Data center request servicing times			
Data center	*Avg(Ms)*	*Min(Ms)*	*Max(Ms)*
DC1	0.74	0.24	1.25
DC2	0.70	0.12	1.94
DC3	0.65	0.12	3.23
DC4	2.62	0.14	6.92
Over all data center request servicing times	1.18	0.12	6.92

Figure 3.15: Test4 Data Center Request Servicing Times

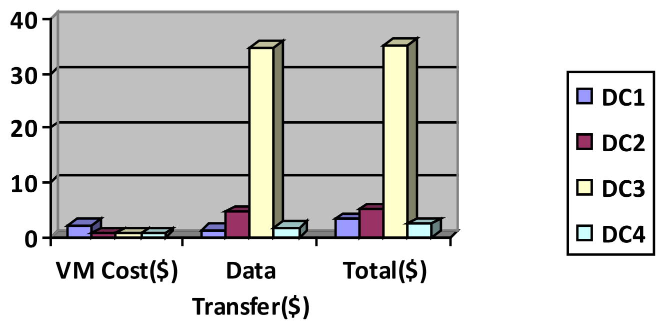


After performing the simulation the data center request servicing times by region increase in result of test4 compare to test3, test2 and test1 result computed by cloud analyst as shown in table 3.33 and figure 3.15.

Table 3.34: Test4 Result Cost [10]

Data center	*VM Cost($)*	*Data transfer cost($)*	*Total($)*
DC1	2.01	1.17	3.18
DC2	0.50	4.49	4.99
DC3	0.50	34.83	35.33
DC4	0.50	1.75	2.25
Total cost	3.51	42.24	45.75

Figure 3.16: Test4 result cost



After performing the simulation the total cost increase in result of test4 compare to test3, test2 and test1 result computed by cloud analyst as shown in table 3.34 and figure 3.16.

9.9 Test 5 – EyeOS Hosted on A Five Data Center

To analyze load balancing for EyeOS Researcher set user bases Configuration parameter, service broker policy set closest data center and load balancing algorithm set round robin as shown in Table 3.35. Add one more Data Center. Now EyeOS hosted on a five Data Center DC1, DC2, DC3, DC4 and DC5 located at region 0, region1, region 2 and region 3, region 4 and region 5 respectively as shown in Table 3.37. After set all Configuration parameter perform, simulation and calculate Overall Response Time Summary, Response Time by Region, Data Center Request Servicing Times, and Cost.

Table 3.35: Test5 Configuration Parameter [10]

Test5	
Test parameter	*Value*
User base	UB1, UB2, UB3, UB4, UB5
Data center	DC1, DC2, DC3, DC4, DC5,
Data center region	0, 1, 2, 3, 4
Service broker policy	Closet data center
Load balancing algorithm	Round Robin

Table 3.36: Test5 Application Deployment Parameter [10]

Service broker policy	*Data center*	*#Vms*	*Image size*	*Memory*	*BW*
Closet data center	DC1	5	10000	512	1000
	DC2	5	10000	512	1000
	DC3	5	10000	512	1000
	DC4	5	10000	512	1000
	DC5	5	10000	512	1000

Table 3.37: Test5 Data Centers Configuration Parameter [10]

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	2
DC2	1	X86	Linux	Xen	0.1	0.05	0.1	0.1	2
DC3	2	X86	Linux	Xen	0.1	0.05	0.1	0.1	2
DC4	3	X86	Linux	Xen	0.1	0.05	0.1	0.1	2
DC5	4	X86	Linux	Xen	0.1	0.05	0.1	0.1	2

6.10 Test 5 – Result

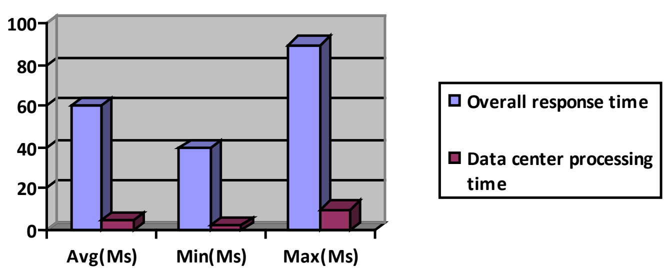
Table 3.38: Test5 Result Overall Response Time Summary [10]

Overall response time summary			
	Avg(ms)	*Min(ms)*	*Max(ms)*
Overall response time	62.47	40.01	84.24
Data center processing time	1.64	0.12	6.92

After performing the simulation the overall response time decrease in result of test 5 compare to test4, test3, test2 and test1 result computed by Cloud analyst as shown in table 3.38 and figure 3.17.

After performing the simulation data center processing time increase in result of test5 compare to test4, test3, test2 and test1 result computed by Cloud analyst as shown in table 3.38 and figure 3.17.

Figure 3.17: Test5 Result Overall Response Time Summary



After performing the simulation the response time by region decrease in result of test5 compare to test4, test3, test2 and test1 result computed by cloud analyst as shown in table 3.39 and figure 3.18.

Table 3.39: Test5 Result Response Time by Region [10]

Response time by region			
User base	*Avg(Ms)*	*Min(Ms)*	*Max(Ms)*
UB1	51.08	41.21	63.65
UB2	53.81	41.39	67.95
UB3	52.10	40.60	63.56
UB4	55.70	40.01	70.83
UB5	65.08	47.90	84.24
Overall response time by region	55.554	40.01	84.24

Figure 3.18: Test5 Response Time by Region

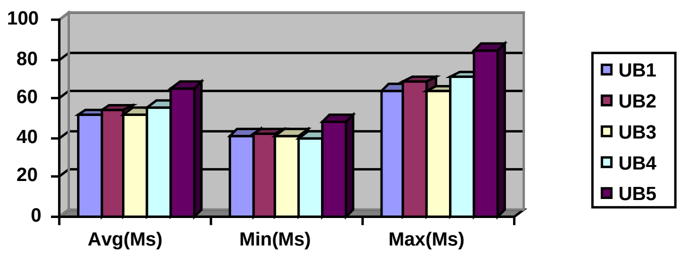
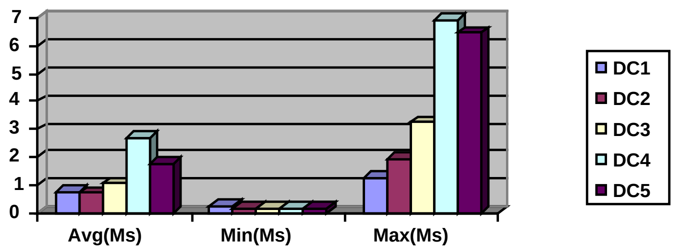


Table 3.40: Test5 Result Data Center Request Servicing Times [10]

Data center request servicing times			
Data center	*Avg(Ms)*	*Min(Ms)*	*Max(Ms)*
DC1	0.74	0.25	1.25
DC2	0.71	0.12	1.94
DC3	1.05	0.12	3.23
DC4	2.69	0.13	6.92
DC5	1.78	0.12	6.48
Over all data center request servicing times	1.394	0.12	6.92

Figure 3.19: Test5 Data Center Request Servicing Times

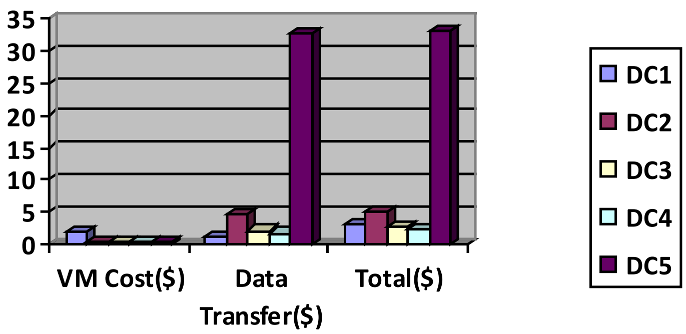


After performing the simulation the data center request servicing times by region increase in result of test5 compare to test4, test3, test2 and test1 result computed by cloud analyst as shown in table 3.40 and figure 3.19.

Table 3.41: Test5 Result Cost [10]

Data center	*VM Cost($)*	*Data transfer cost($)*	*Total($)*
DC1	2.01	1.17	3.18
DC2	0.50	4.49	4.99
DC3	0.50	2.09	2.59
DC4	0.50	1.75	2.25
DC5	0.50	32.74	33.24
Total cost	4.01	42.24	46.25

Figure 3.20: Test5 Result Cost



After performing the simulation the total cost increase in result of test5 compare to test4, test3, test2 and test1 result computed by cloud analyst as shown in table 3.41 and figure 3.20.

6.11 Result Comparisons of Test1, Test2, Test3 Test4, Test5

Table 3.42: Result Comparison of Overall Response Time Test1, Test2, Test3, Test4, and Test5 [10]

Overall Response Time (ORT)					
ORT	*Test1*	*Test2*	*Test3*	*Test4*	*Test5*
Avg(Ms)	452.31	436.58	260.71	250.36	62.47
Min(Ms)	41.07	41.21	40.70	40.01	40.01
Max(Ms)	655.89	656.04	396.35	396.35	84.24
Total ORT	1149.27	1133.83	697.76	686.72	186.72
ORT (%)	3.8309	3.7794	2.3259	2.2891	0.6224

After performing the simulation the overall response time decrease of test5 compare to test4, test3, test2, test1 result conducted by cloud analyst as shown in Table 3.42 and figure 3.21.

Figure 3.21: Result Comparison of Overall Response Time Test1, Test2, Test3, Test4, and Test5

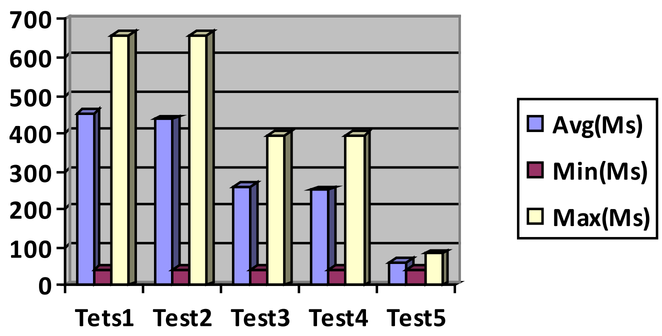
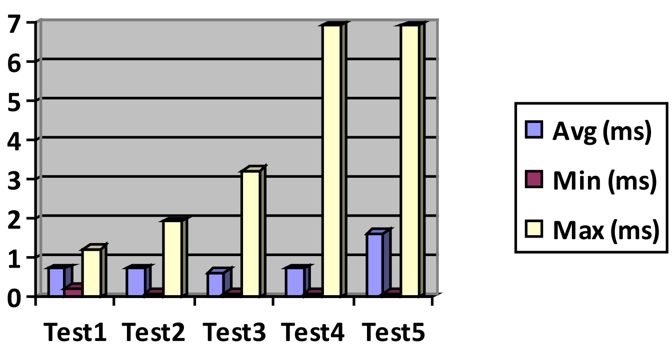


Table 3.43: Result Comparisons of Overall Data Centre Processing Time of Test1, Test2, Test3, Test4, and Test5 [10]

Overall Data Processing Time (ODCPT)					
	Test1	*Test2*	*Test3*	*Test4*	*Test5*
Avg (ms)	0.74	0.74	0.66	0.74	1.64
Min (ms)	0.24	0.12	0.12	0.12	0.12
Max (ms)	1.25	1.94	3.23	6.92	6.92
Total ODCPT	2.23	2.8	4.01	7.78	8.68
ODCPT (%)	0.0074	0.0093	0.0133	0.0259	0.0289

Figure 3.22: Overall Data Processing Times of Test1, Test2, Test3, Test4, and Test5



After performing the simulation the overall data processing time increase in test5 compare to test4, test3, test2, test1 result conducted by cloud analyst as shown in Table 3.43 and figure 3.22.

After performing the simulation the overall response time by region decrease in test5 compare to test4, test3, test2, test1 result conducted by cloud analyst as shown in Table 3.44 and figure 3.23.

Table 3.44: Result Comparisons of Overall Response Time by Region of Test1, Test2, Test3, Test4, and Test5 [10]

Overall response time by region (ORTR)					
	Test1	*Test2*	*Test3*	*Test4*	*Test5*
Avg(ms)	314.598	284.632	154.16	104.02	55.554
Min(ms)	41.21	41.21	40.7	40.01	40.01
Max(ms)	656.04	656.04	396.35	396.35	84.24
Total ORTR	1011.85	981.882	591.21	540.38	179.804
ORTR (%)	3.3728	3.2729	1.9707	1.8013	0.5993

Figure 3.23: Overall Response Times by Region of Test1, Test2, Test3, Test4, and Test5

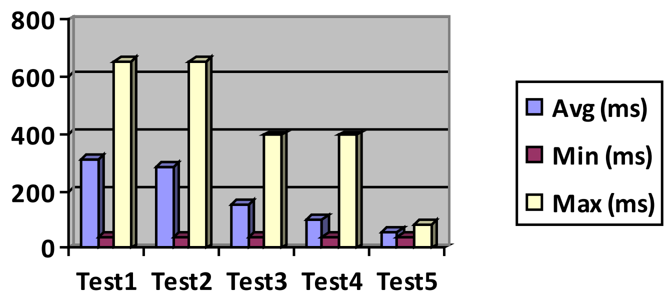
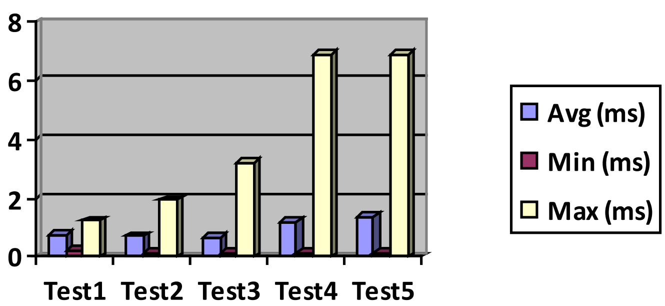


Table 3.45: Result Comparison of Overall Data Center Request Servicing Times of Test1, Test2, Test3, Test4, and Test5 [10]

Overall Data center request servicing times (DCRST)					
	Test1	*Test2*	*Test3*	*Test4*	*Test5*
Avg(ms)	0.74	0.72	0.69	1.17	1.39
Min(ms)	0.24	0.12	0.12	0.12	0.12
Max(ms)	1.25	1.94	3.23	6.92	6.92
Total DCRST	2.23	2.78	4.04	8.21	8.43
DCRST (%)	0.0074	0.0092	0.0135	0.0274	0.0281

Figure 3.24: Overall Data Center Request Servicing Times of Test1, Test2, Test3, Test4, and Test5

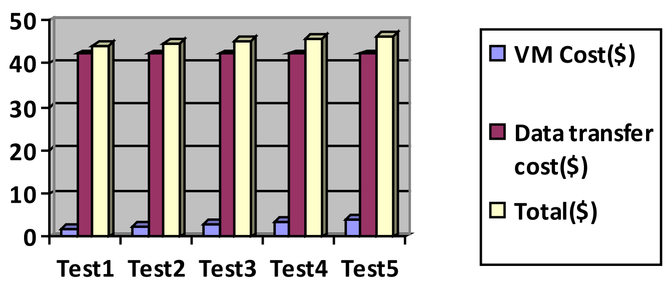


After performing the simulation the overall data center request servicing times increase in result of test5 compare to test4, test3, test2 and test1 result computed by cloud analyst as shown in Table 3.45 and Figure 3.24.

Table 3.46: Result Comparisons of Overall Total Cost of Test1, Test2, Test3, Test4, and Test5 [10]

Overall Total Cost					
	Test1	*Test2*	*Test3*	*Test4*	*Test5*
VM Cost ($)	2.01	2.51	3.01	3.51	4.01
Data transfer Cost ($)	42.24	42.23	42.23	42.24	42.24
Total ($)	44.25	44.74	45.24	45.75	46.25
Total for overall total cost ($)	88.49	89.48	90.48	91.5	92.5
Overall total cost (%)	0.2949	0.2982	0.3016	0.3050	0.3083

Figure 3.25: Overall Total Costs of Test1, Test2, Test3, Test4, and Test5



After performing the simulation the overall total cost little bit increase in result of test5 compare to test4, test3, test2 and test1 result computed by cloud analyst as shown in Table 3.46 and Figure 3.25.

7. Conclusions

In this research paper, we developed load balancing framework for EyeOS. Developed framework is useful when particular server overloaded. So that load will be distributed depending upon service broker policy and load balancing algorithm across the multiple servers. We tested 5 tests with different scenario each and every time some parameter is fix such as User base and adding Data center in each test. We conclude that more quantity of Data centers provide positive result about Overall Response Time, Response Time by Region is decrease.

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