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Implementation of Raaes: Reliability-Assured and Availability-Enhanced Storage System

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Abstract—Cloud computing is clutching and tantalizing the world and taking the distributed computing archetype into different dimensions with different names in recent decades. In today's scenario, 99 percent of the organizations and even the common people are migrating to adopt storage services on cloud for their business and personal usages because of its attractive and beneficial features with less maintenance. The most popular service providers like Google, amazon, Yahoo, and Microsoft are increasing their users to millions in every moment because of their attractive and promoting mechanisms. But, at the same time, their services are hosted from different data centers that contain thousands of servers, as well as power delivery (and backup) and networking infrastructures. In this scenario, when users demand high availability and low response times, each service is mirrored by multiple data centers that are geographically distributed. This may leads the high cost for maintenance and some challenges to provide integrity and consistency. So, the predecessor of this research work investigated the issues in Providers' and user' perspective to provide cost-effective optimized cloud storage while meeting the reliability and availability requirement throughout the whole Cloud storage process. And also, the research has proposed the RAAES framework to optimize and to provide efficient cloud Storage in order to significantly reduce the occupied space and cost jointly with meeting the reliability assurance requirements. Thus, through this paper this research has been proven that it could ultimately reduce the request-response time delay while enhancing the availability requirements by implementing the RAAES, hence it has a positive effect on promoting the development of Cloud by an efficient Storage.

Keywords—File Replication, Replica Management, Cloud Storage, Availability Enhancement, Reliability.

1.INTRODUCTION

Cloud computing has suddenly been fascinated by all types of users in recent years. Perhaps a paradigm of distributed computing that works with the concept of "on-demand" or "pay-as-you-go." In cloud computing, all computing resources (memory, data, etc.) are shared between users [1, 2, 3]. Service level agreements (SLAs) connect users to service providers. This wacky and deftly agreement defines QoS parameters such as availability, reliability, scalability, storage, and cost [11 and 18]. Cloud storage is a representation of a file or data storage where digital records are stored in a logical collection. In physical storage, data stored in multiple data centers (and in a common location) is managed by the hosting company [8]. These cloud storage sources are responsible for ensuring that records are available and accessible. Today, most people and organizations are switchover to ingrained cloud storage with gratification.

So, popular internet companies like Google, Yahoo, and Microsoft are enticing millions of users with their wacky services every day. These services are hosted in a data center that includes thousands of servers, power supplies (and backups), and network infrastructure. As users demand high availability and short response times, each service is cloned by multiple geographically dispersed data centers [14 and 18]. Other terms for this type of service are file replication, data replication, and remote storage replication.

The cloud storage replication service provides prolific provisioning of invaluable redundancy in the event of a backup system main storage failure. The moment cloud users can access the replicated data to minimize downtime and associated costs [16, 21, 22]. Proper implementation of the service can provide a more efficient disaster recovery process by continuously making replica copies of the entire backed up file [9].

Replication is a method of storing multiple copies of a data file in a data center for performance and availability reasons. Since the cloud is an on-demand model, users will have to pay for cloud storage or use free storage services. Cloud service providers (CSPs) that guarantee (high) maximum demand are always bespoke desires of the users. As a result, use replication for maximum availability [9, 12, 14, and 15]. However, at the same time, the benefits of replication do not have to be greater than the costs indulged.

The Cloud data storage process relies on the profoundly engrossed replication-based storage system because the number of replicas directly impacts the occupied space, storage residential cost, reliability, availability and request-response delay time. In order to store data in the cloud at a low cost, the cloud storage users need to consider the number of copies and the occupied space of that copy while maintaining the reliability and data availability of data throughout the life cycle of the cloud. The predecessor of the research [4, 5 and 6], the features of the DRRRA[6], DRCAES [5] are combined together. and Utilization Cost Calculation (UCC) [4] that cooperates with DRRRA and DRCAES for keeping the vast amount of Cloud data files. In this paper, the whole RAAES [4] is evaluated and explained in detail. J2EE technology and CloudMe cloud storage technology are used in validation.

The anatomy of this paper is, Section 2 stated the related works and the existing framework. Section 3 presents the proposed RAAES system such as, the cost calculation model in detail with worked-out examples, combines the features of DRRRA and DRCAES algorithms by RAAES algorithm which is described in detail and the performance evaluation and the validations are also provided. Next, in section 4, the results and comparisons of RAAES, highlighted key features of the proposed RAAES are discussed in detail. In section 5, concludes the works presented in this paper.

2.RELATED WORKS:

The current Cloud Storage System (CSS) functionalities were analyzed from the perspective of the reviewer which is represented in [4 and 18]. In order to eliminate data redundancy issues, the research needs to consider the arrangement of the most common services carefully and the applications used to provide services on other storage [1, 3, 8, and 9]. Such applications are typically instrumented as multi-layered applications running in distributed software systems According to the storage strategies currently used, the number of requests is the primary factor for computing the popularity of the files when a multi-tier application user submits the request [4]. In the current research of data replication in cloud servers, the hitting files indicate the research's limitation of hypothetical investigations without realistic considerations or heuristics-based executions with an unprovable performance guarantee. An aspect of this work directly related to replication is the process of data replication and request-response on cloud servers. This is an optimization problem of static resources on users' access to cloud storage [7].

They show that this problem is NP-hard and requires delay. This means that there is currently no polynomial algorithm that gives an accurate solution. They only consider static data replication for proper analysis. The limitation of the static approach is that replication cannot tune dynamically changing user access prototypes [12 and 14]. Also, the centralized process of integer programming cannot be easily implemented on distributed cloud servers. However, the rounded progress of the optimal solution for the linearly programmed modeling of the problem cannot be easily implemented in a distributed manner [15 and 20]. This task follows the same path (that is, uniform data size), but plans a polynomial time-domain approximation algorithm that can be easily implemented in a distributed environment such as a cloud server [8]. Request/response and resource sharing use the auction protocol to select replication and trigger long-term optimization with file access patterns. It proposes a utility-based replication strategy on cloud servers. This process deals with data replication for availability in the face of unreliable work. This is different from this optimization task [14 and 15]. Randomly collecting duplicate targets ignores server heterogeneity (that is, different servers have different data request processing and network capabilities). Almost half of all Crossrack traffic was written because replicas were created in the production cluster of search engine applications. The networks in a cluster are often underutilized, but there are some congested connections due to imbalances in-network utilization [10]. To accept the issue of multi-facility cloud resource allocation, they are primarily involved in solutions suitable for parallel implementation. There are many reasons for this [19 and 23]. First, the cloud resource allocation problem is essentially a significant convex resource optimization problem with millions of variables or more. The centralized process of cloud server resource allocation solvers is extremely inefficient in solving such large cloud storage problems [10, 16, and 21].

2.1 EXISTING FRAMEWORK

The existing Cloud Storage System (CSS) has two primary components which are the user interface and the server. Data replication is extensively in use in current Cloud storage systems for data reliability and availability. Cloud storage systems like Amazon, Google File System, Hadoop, Windows Azure, and Distributed File System are all using multi-replica data replication approaches, as mentioned in the introduction. By default, 3 replicas (including the original) of all data are retained within those Cloud storage systems. Even though more than three clones for each piece of data could be generated if requested, the 3-replica mode is the most common. Therefore, this research calls this related data replication approach [16].

3.THE PROPOSED RAAES (RELIABILITY-ASSURED AND AVAILABILITY-ENHANCED STORAGE) ALGORITHM:

The proposed RAAES algorithm is used to combine the features of DRRRA and DRCAES algorithms, Cost calculation is also done in the proposed RAAES model.

```
Input    : Every user activities
Output   : Optimized Replica and optimized Cost.

Step 1 :     If Time_Th staisfied
                 Call_DRRRA()
Step 2 :     For all user activity
                 Call_DRCAES()
                 Call_UCC()
Step 3 :     End
```

3.1.IMPLEMENTATION OF RAAES

Implementation or validation is done using Java technology and CloudMe cloud storage. Local host validation is only done in this stage, but files are uploaded in CloudMe cloud storage. The implementation flow is presented in figure 3.1 in detail. When the user requests to access, the system checks their authentication. Authentication checking is done using the username and password method. It is assigned during initiation or registration time itself. Two kinds of people may access this model - one is the service provider (Admin), and the others the service consumer (user).

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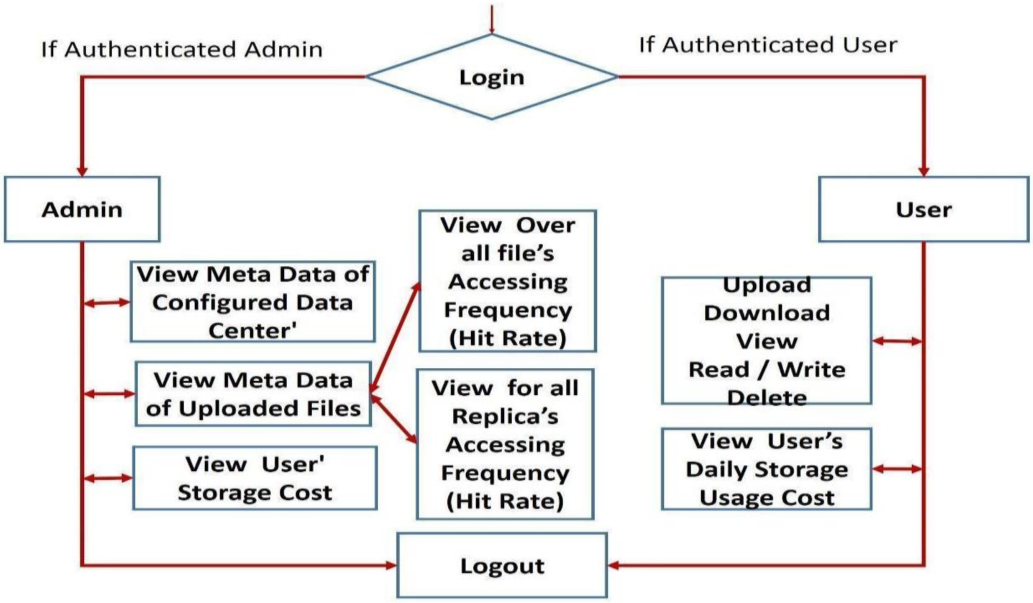
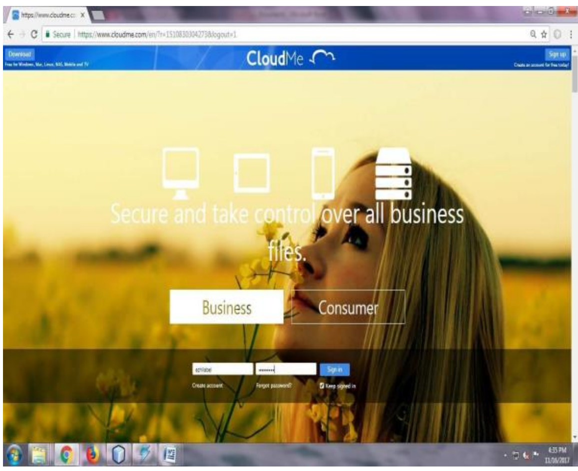


Figure 3.1.Flow of the proposed RAAES Implementation

The admin can monitor all kinds of activities made by the user, and they can view all users' pricing models. They can view Metadata of configured datacenters and uploaded files such as storage capacity of DC, Available Space (AS) Occupied Space (OS), Uploaded files' size, type, uploaded time, number of replicas, number access, and type of access. Similarly, they can view all users' utilization cost, Initial cost and remaining cost and validity.

All mentioned activities of the approaches implementation screenshots are presented in Figure 3.2 to figure 3.10 which includes, CloudMe Login page, Datacenter view in CloudMe, RAAES datacenter configuration, User page, Admin view, Cost view in both user and admin, replica minimization process, dynamic replica placement, metadata of DC and files and so on.



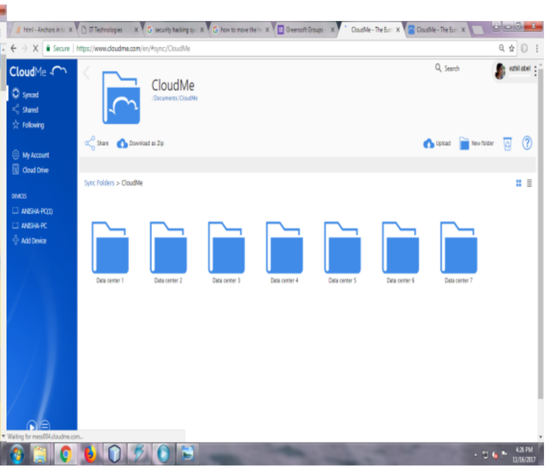


Figure3.2.CloudMe Login Page Figure3.3. Data Center View in CloudMe

Figure 3.4 shows the initial data configuration details. There are seven DCs that are configured with 5GB memory for validation purpose.

JOURNAL OF ALGEBRAIC STATISTICS
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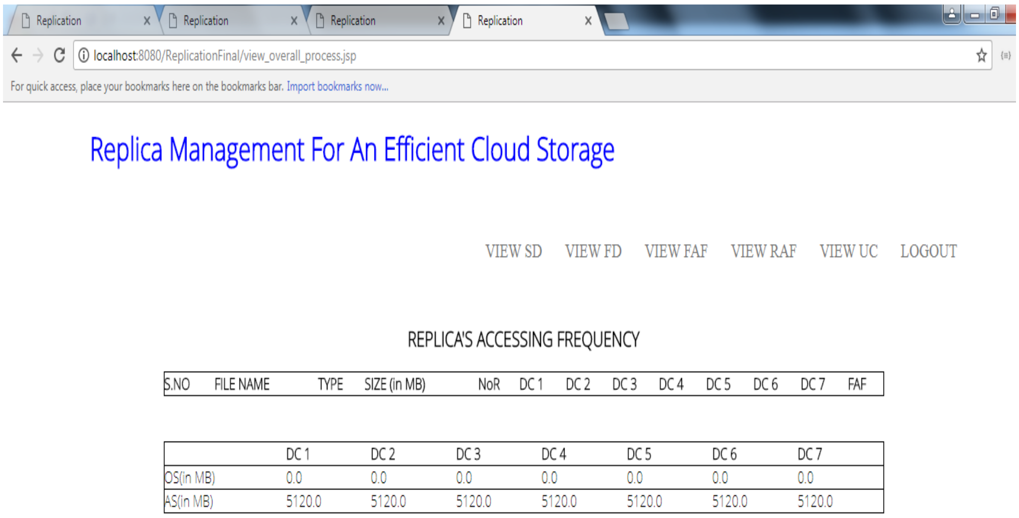

Figure 3.4. Sample initial Data Center Configuration

Figure 3.5 and 3.6 shows the user interface of user activities for the initial cost plan and the utilization cost after performance of user activities respectively.

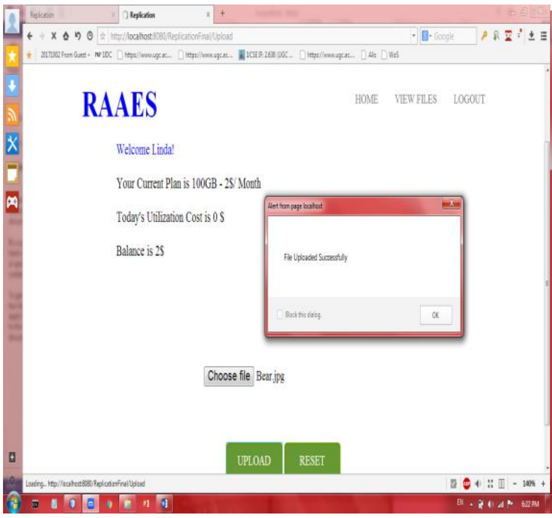

Figure3.5. Initial User Home Page before Uploading a File

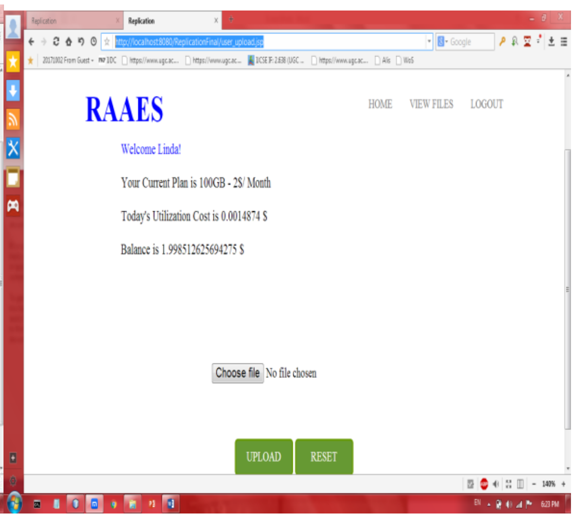

Figure3.6. User Home Page after Uploading a File

Figure 3.7 and 3.8 shows File Accessing Frequency (FAF) and Replica Accessing Frequency (RAF) after performance of the proposed DRRRA approach which is discussed in [6].

JOURNAL OF ALGEBRAIC STATISTICS
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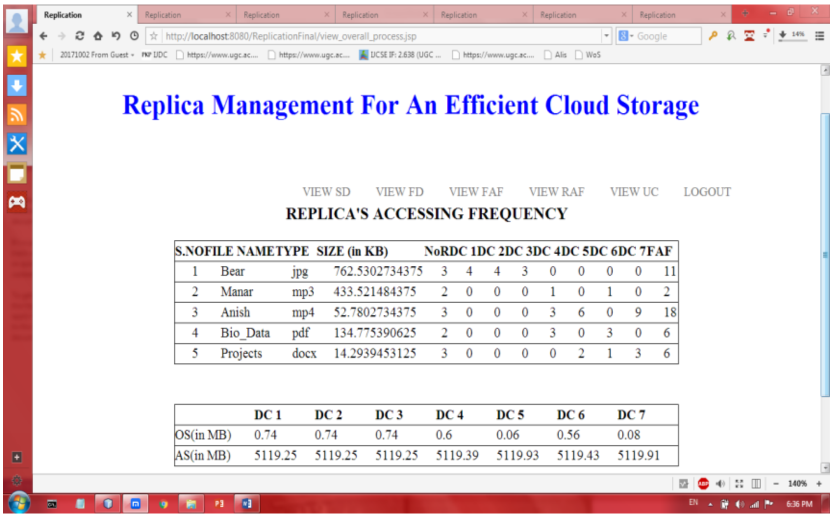


Replica Management For An Efficient Cloud Storage

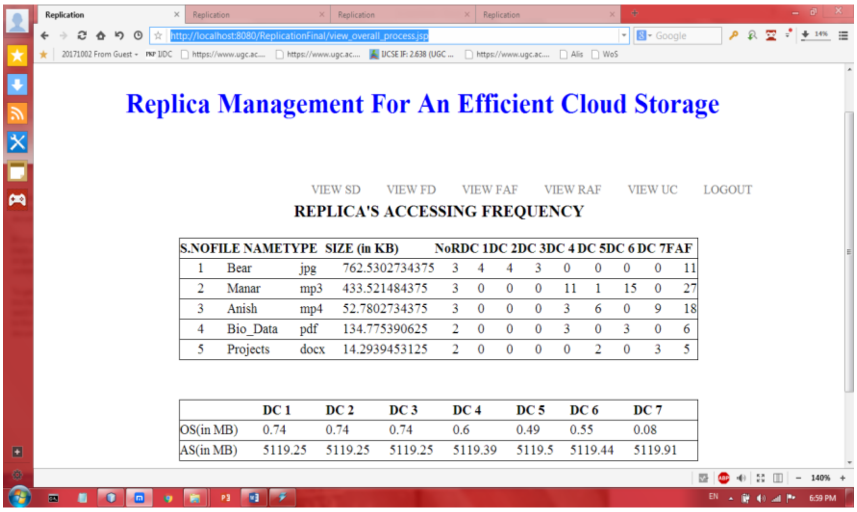
VIEW SD VIEW FD VIEW FAF VIEW RAF VIEW UC LOGOUT

REPLICA'S ACCESSING FREQUENCY

S.NO	FILE NAME	TYPE	SIZE (in KB)	NoR	DC 1	DC 2	DC 3	DC 4	DC 5	DC 6	DC 7	FAF
1	Bear	jpg	762.5302734375	3	4	4	3	0	0	0	0	11
2	Manar	mp3	433.521484375	2	0	0	0	1	0	1	0	2
3	Anish	mp4	52.7802734375	3	0	0	0	3	6	0	9	18
4	Bio_Data	pdf	134.775390625	2	0	0	0	3	0	3	0	6
5	Projects	docx	14.2939453125	3	0	0	0	0	2	1	3	6

	DC 1	DC 2	DC 3	DC 4	DC 5	DC 6	DC 7
OS(in MB)	0.74	0.74	0.74	0.6	0.06	0.56	0.08
AS(in MB)	5119.25	5119.25	5119.25	5119.39	5119.93	5119.43	5119.91

Figure3.7 Admin Page: View for RAF after Reduced Replica (DRRRA)[6]



Replica Management For An Efficient Cloud Storage

VIEW SD VIEW FD VIEW FAF VIEW RAF VIEW UC LOGOUT

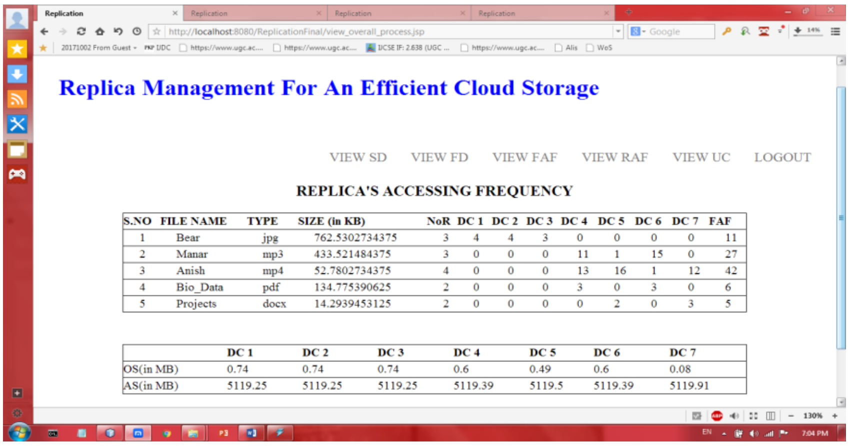
REPLICA'S ACCESSING FREQUENCY

S.NO	FILE NAME	TYPE	SIZE (in KB)	NoR	DC 1	DC 2	DC 3	DC 4	DC 5	DC 6	DC 7	FAF
1	Bear	jpg	762.5302734375	3	4	4	3	0	0	0	0	11
2	Manar	mp3	433.521484375	3	0	0	0	11	1	15	0	27
3	Anish	mp4	52.7802734375	3	0	0	0	3	6	0	9	18
4	Bio_Data	pdf	134.775390625	2	0	0	0	3	0	3	0	6
5	Projects	docx	14.2939453125	2	0	0	0	0	2	0	3	5

	DC 1	DC 2	DC 3	DC 4	DC 5	DC 6	DC 7
OS(in MB)	0.74	0.74	0.74	0.6	0.49	0.55	0.08
AS(in MB)	5119.25	5119.25	5119.25	5119.39	5119.5	5119.44	5119.91

Figure3.8. Admin Page: View for RAF after Replica Creation (DRCAES) [5]

Figure 3.9 shows File Accessing Frequency (FAF) and Replica Accessing Frequency (RAF) after performance of the proposed RAAES approach which is discussed in [7].



Replica Management For An Efficient Cloud Storage

VIEW SD VIEW FD VIEW FAF VIEW RAF VIEW UC LOGOUT

REPLICA'S ACCESSING FREQUENCY

S.NO	FILE NAME	TYPE	SIZE (in KB)	NoR	DC 1	DC 2	DC 3	DC 4	DC 5	DC 6	DC 7	FAF
1	Bear	jpg	762.5302734375	3	4	4	3	0	0	0	0	11
2	Manar	mp3	433.521484375	3	0	0	0	11	1	15	0	27
3	Anish	mp4	52.7802734375	4	0	0	0	13	16	1	12	42
4	Bio_Data	pdf	134.775390625	2	0	0	0	3	0	3	0	6
5	Projects	docx	14.2939453125	2	0	0	0	0	2	0	3	5

	DC 1	DC 2	DC 3	DC 4	DC 5	DC 6	DC 7
OS(in MB)	0.74	0.74	0.74	0.6	0.49	0.6	0.08
AS(in MB)	5119.25	5119.25	5119.25	5119.39	5119.5	5119.39	5119.91

Figure 3.9. Admin Page: View for RAF after Replica Creation (RAAES) [4]

JOURNAL OF ALGEBRAIC STATISTICS
Volume 13, No. 2, 2022, p. 3711-3720
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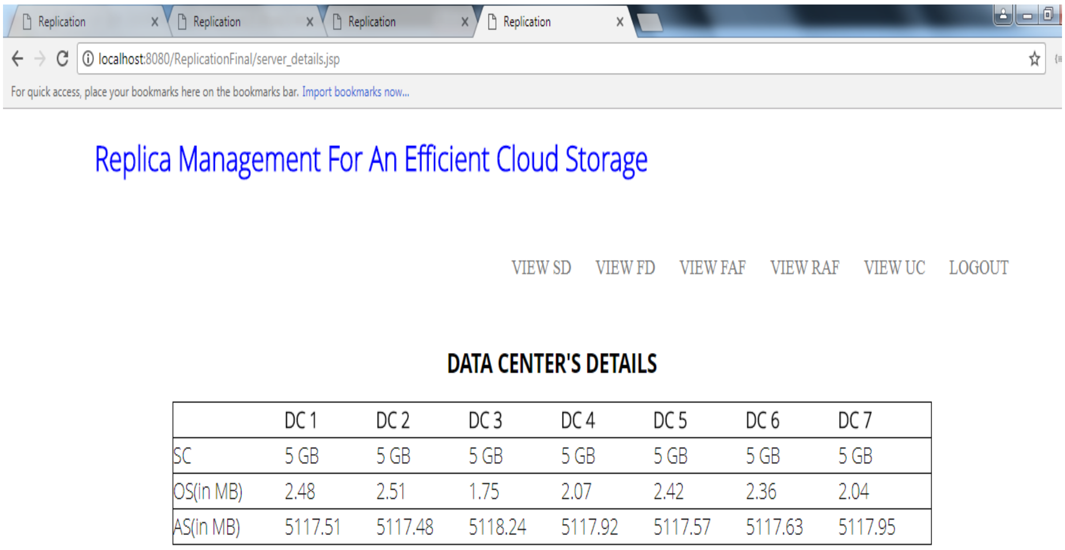
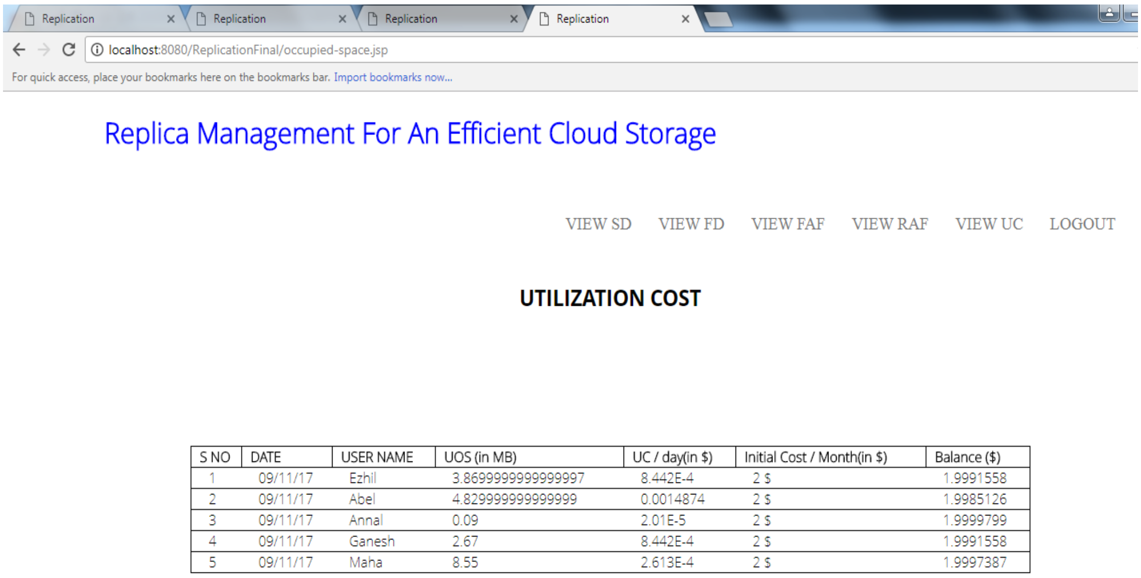
ISSN: 1309-3452



	DC 1	DC 2	DC 3	DC 4	DC 5	DC 6	DC 7
SC	5 GB	5 GB	5 GB	5 GB	5 GB	5 GB	5 GB
OS(in MB)	2.48	2.51	1.75	2.07	2.42	2.36	2.04
AS(in MB)	5117.51	5117.48	5118.24	5117.92	5117.57	5117.63	5117.95

Figure 3.9 Admin Page: Data center' Details

Figure 3.10 shows admin interface which helps to monitor the different users' utilization cost and balances, etc.



S NO	DATE	USER NAME	UOS (in MB)	UC / day(in $)	Initial Cost / Month(in $)	Balance ($)
1	09/11/17	Ezhil	3.8699999999999997	8.442E-4	2 $	1.9991558
2	09/11/17	Abel	4.829999999999999	0.0014874	2 $	1.9985126
3	09/11/17	Annal	0.09	2.01E-5	2 $	1.9999799
4	09/11/17	Ganesh	2.67	8.442E-4	2 $	1.9991558
5	09/11/17	Maha	8.55	2.613E-4	2 $	1.9997387

Figure3.10. Admin Page: Utilization Cost Details for different Users

4.FINDINGS AND INTERPRETATIONS

Table4.1. presents the comparison of parameters such as Number of Replicas (NR), Occupied Space (OS), Cost, Request-Response Time Delay (RR_TD) along with reliability and availability concerns of the proposed RAAES with existing PRC algorithm. The optimized cost is obtained without affecting the existing reliability assured percentage and the availability is enhanced as well.

JOURNAL OF ALGEBRAIC STATISTICS
Volume 13, No. 2, 2022, p. 3711-3720
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Table 4.1. Comparisons of RAAES with existing PRC algorithm

	Number of Replicas	Occupied Space	Cost	Reliability	Availability	Request-Response Time Delay
Existing PRC [Wen, 16]	1 or 2 or 3 Decide Based on Disk Failure Rate	Minimized Based on number of Replicas	Minimized Based on number of Replicas	No reliability with no replica 95% Assured with 2-replica 99% for 3-replica	Not Considered	Increased for more request
Proposed RAAES	**2-Replica is Minimum and Maximum is decided Based on FAF and SLA**	**Optimized**	**Optimized**	**95% Assured with 2-replica [Wen, 16]**	**Enhanced**	**Decreased**

Thus, from the table, it is clearly understood that the proposed RAAES provides efficient data storage in the cloud environment. It is a cost-effective, optimized storage with data reliability and availability concerns.

Here, the cost is optimized through optimizing the frquency of replicas without affecting the existing reliability concerns. That is, the reliability is not enhanced or improved, but the existing PRC algorithm assured reliability is maintained with optimized replica numbers.

The top existing Cloud Storage providers such as Google Drive, Amazon, DropBox, iCloud, OneDrive and Microsoft Azure are compared with the proposed RAAES model in Table 4.2. Here, some of the important features are considered in comparison such as~~,~~ upgraded fees, validity, drawback and best suit for whom.

Table 4.2. Comparison of proposed RAAES with top leading Cloud Storage Providers'

S. No	Features	Cloud Service Provider' Name						
		GoogleDrive [1]	Amazon [2]	DropBox [3]	iCloud [4]	OneDrive [5]	MicroSoft Azure [6]	Proposed RAAES
1	**Upgrade Fees**	2 $ /month	$11.99 per year and offers *Standard - Infrequent Access Storage* $0.0125 per GB Glacier Storage $0.004 per GB (Static Plan Selection)	50 GB at $1.99 per month	0.99 $ / month	50 GB at $1.99 per month	Different Upgraded Fees Blob Storage Queue Storage File Storage Disk Storage (Static Plan Selection)	$0.00067 per GB per day Pay only utilization Cost. (For Testing only. For real-time implementation the provider who adopt this Idea they can decide)
2	**Storage Utilization Cost**	If the validity is over the balance amount will be lapsed.	Differ Based on Plan **(Static Plan Selection)**	If the validity is over the balance amount will be lapsed.	If the validity is over the balance amount will be lapsed.	If the validity is over the balance amount will be lapsed.	Differ Based Plan **(Static Plan Selection)**	But here, If the Validity is over the balance amount will be carried out when the user re-entered. Pay for Usage (Low cost for Rarely accessed Storage).
3	**Drawback**	High cost for above 1TB	**Static Plan Selection**	High cost	Apple users	High cost	High cost Because High Backup	Disaster recovery
4	**Best For?**	Free users Because, easy to synchronize with other Google Services.	**Paid Users. Large Business.**	Small or Medium Business	Apple users	Small Business	Business People who needs High Backup and Reliable Service	Small, Medium or Large Scale Business People as well as Personal Usage User

The proposed RAAES would be an alternative cloud storage which is competing with everyone; and it has the best pricing model as well. So, it is an alternative to everyone.

5.CONCLUSION:

In this paper, the implementation of the novel cost-effective data reliability and availability assurance mechanism named as RAAES (Reliability Assured and Availability Enhanced Storage) for maintaining the data in the Cloud with a huge number of data files in a cost-effective fashion is presented. This framework comprises the following mechanisms. First, the cost calculation pattern of the proposed RAAES framework is explained. Second, the working process of the two major parts of the proposed RAAES are presented. That is, the user interface and the proposed RAAES node are presented in detail by following the lifecycle of a data file managed by DRRRA and DRCAES with FAFR in the Cloud. Third, evaluating the proposed RAAES by relating it with the broadly used traditional 3-replica data storage strategy is done. Finally, the top leading Cloud Storage Providers' are compared with the proposed RAAES which proves that the competing and alternative cloud storage with everyone is the proposed RAAES; and it has the best pricing model. Hence, based on the analysis of the current work, in future, it can be move on in the following aspects: the time and space complexity issues would be addressed and disaster recovery will be considered.

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