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A Comparative Study to Simplify Disaster Recovery In Cloud

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Abstract ;Disaster recovery can be defined as a process that uses various methods, methodologies, and ways which can be used to curb the effect of a disaster, that has occurred in computing systems, due to various significant factors such as system failures, cyber-attacks, and human error, this is done to ensure minimal downtime in the systems, a disaster in the cloud refers to any hindrance that stops the continuity of activities and services on the cloud system, due to various factors such as system failures, human error ,disaster recovery involves the retrieval of data and information that has been either lost or placed at risk due to a catastrophic event

Various problems are faced during a disaster as business shuts down , facilities are put on halt, and the porosity of data is at its peak, various ways have been used to resolve the effect of disaster recovery and ensure business continuity such as system frameworks for data storage, and disaster recovery models based on specific criteria, data backup systems, replication technology, Most of this proposed solution s, did not give much concern to the major detrimental factors that ensure the effective and rapid restoration from a disaster , such as RPO, RTO , fail-over time etc.

This study aims to assess two systems and ascertain which one demonstrates greater efficiency in addressing disaster recovery within cloud computing. The two factors used for comparison are; Recovery Time Objective (RTO); which is the time duration between disruption and restoration of services in a cloud system and Recovery Point Objective (RPO); which denotes the amount of data lost after a disruption and data have to be recovered to the exact point. We examined how the two systems make the procedures for disaster recovery seamless and simple for users. We compared and contrasted them to see which had a larger advantage in solving the problem. We proposed the best solution and how these solutions may be readily applied and used.

Keywords*: Disaster recovery, Cloud, RTO, RPO*

1. **Introduction**

A disaster constitutes a catastrophic event causing widespread destruction and distress that outstrips local capacity to manage alone, necessitating external assistance [10]. Disaster recovery involves reconstituting infrastructures, services, livelihoods, and rehabilitation post-disaster, aiming to restore normalcy by systematically addressing impacts.

Disasters impose severe detrimental effects across economic, health, social, cultural, political spheres [25]. Direct damages to housing, infrastructure and agriculture may amount to billions in losses. Indirect costs through mortality, disrupted trade, and ecosystem impacts amplify over time. Psychosocial distress also arises, underscoring holistic recovery needs.

Various methods to enhance disaster recovery exist. Geographic information systems facilitate coordinated data gathering for recovery planning [27]. Strengthening local governance improves resource mobilization [7]. Multi-sector partnerships with NGOs, private sector fill capability gaps [5]. Integrating indigenous knowledge makes strategies socio-culturally relevant [25]. Regular disaster training and evacuation drills raise preparedness (Ronoh et al., 2019). And resilient infrastructure limits future risks [12]. Effectively linking these methods remains vital.

An integrated approach coupling technological innovations with community-centered resilience thus holds immense potential to mitigate the variegated repercussions of disasters and empower effective recovery.

The rest of the paper will be as follows: Sec II Literature review of related works, Sec III contains the methods and comparisons, Sec IV contains the implementation and result, Sec V contains the conclusion.

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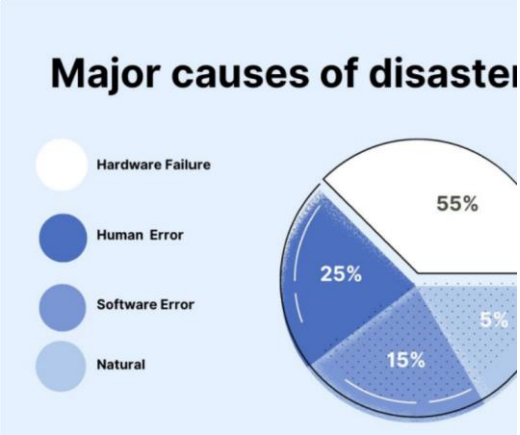

Fig 1 Major Causes of disaster

2. Literature review

Opportunistic networks facilitate communication in challenging environments like disaster areas through store-carry-forward based routing leveraging node mobility [20]. However, security remains a concern given links between unfamiliar nodes. Prior schemes like SEOR [16] focused on secure message transmission through probability-based cooperation incentives yet depend heavily on continuous node movement.

Existing works recognize that slowed human mobility hampers routing performance during disaster events. To address this, [12] optimize probabilities governing transmission behavior promoting neighbor connectivity. However, stagnant nodes still suffer isolation. [22] then integrate node control algorithms enabling unmanned aerial vehicles to fetch messages from disconnected ground-level nodes.

While overcoming stall, aerial transport consumes massive energy reserves quickening exhaustion as simulations confirm [22]. Hybrid networking through integrating infrastructure with opportunistic contacts could assist if infrastructure survives regional disasters. Recent frameworks likeelihood-based infrastructure-supported routing achieve efficient delivery leveraging users social ties [27].

But relying on infrastructure coupled with limiting delivery to social circles risks communication blackouts during wide-area disasters.

3. Methods and Comparisons

Mechanisms Used; It is to be noted that the two works in comparison have different methods in which they both approached the problem, and still made sure to reference the RPO and RTO which are the pivotal points in cloud disaster recovery as these various works ventured into different aspects which affect the cloud disaster recovery, and how their method, system, analogy will efficiently solve this problem.

[3], took a system of core/context analysis theory, where the system is divided into server storage and server networks, the purpose is a disaster recovery operation scheme that will enable the recovery system to make analysis using the core/context scheme, to divide the system so it could be easily analyzed. the disaster recovery system using the scheme is built in advance to ensure they are well segmented to handle a disaster occurred in the cloud, in this system analysis, it is also noted that the core/context system does not exist in the same space as the core, it is a system for processing, transferring and delivering unique identification, for each core/context system there are mission-critical elements and non-mission critical elements, which are the elements which are crucial for the organization's success, while non-mission critical are the other set of data which are also relevant not just as the mission-critical, and in so bearing the mission-critical and non-mission critical do not cause the same the disaster situation, as if data is lost in a mission-critical, it is more likely to cause damage to the organizations security and efficiency than if it were to be non-mission-critical data lost.

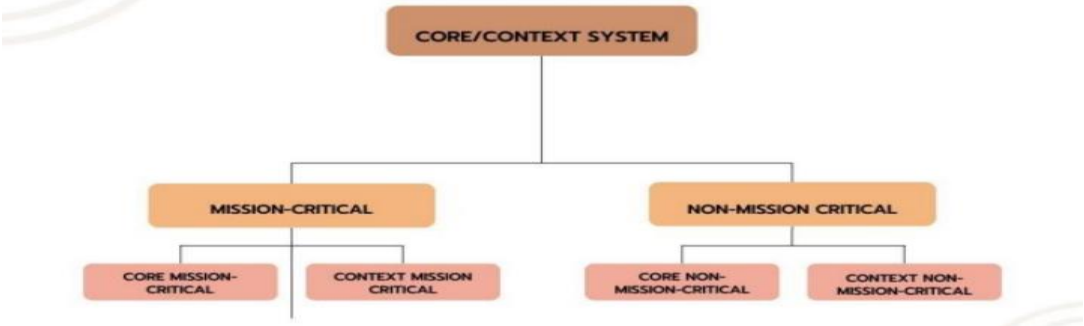

Fig 2. Core/context system

[13]**,** The CBADROM system which is a cloud-based disaster recovery model, works based on the emphasis of costs, and critical risk levels, this model would allocate more resources when there is a higher likelihood of failure, the model is vendor independent meaning it can run on any cloud service provider.

The main factors of this model are; Cost, critical levels, risk level, and disaster recovery tier, the critical level represents how valuable or important the data is, the risk level shows the gravity of the risk ratio on the model and which is usually caused by hardware/software failure, the disaster recovery tiers enumerates the tiers of disaster recovery and how they facilitate the RPO/RTO experience those tiers are the warm site, cold site,

and hot site disaster recovery tiers, and the cost is a very key factor is the determinant of the values of resources and how they are spent in a decisive manner, as small enterprises don't want to waste money on storage and recovery systems

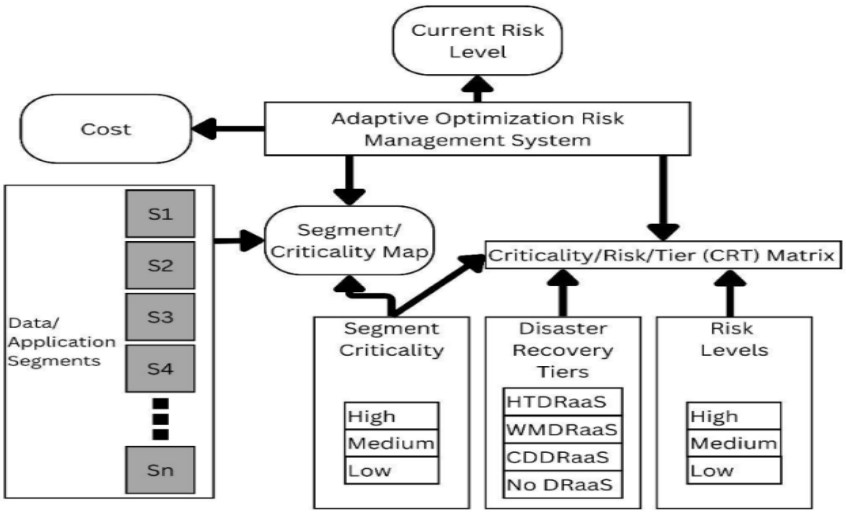

Fig 3. This image shows the CBADROM system format

A cloud-based disaster recovery model is created, which is used to divide the various elements of the recovery into segments and focuses on the constraint of cost to better improve the RPO /RTO of the recovery system, the goal of creating this model to have a flexible adaptive optimization disaster recovery that manages resources, this model respect the different disaster recovery tiers which are the cold, warm, and hot disaster recovery tiers, this model assumed risk changes over time, based on the crisis at hand and level of disaster, the storage is divided into segments, and each segment is associated with a criticality level.

In this study it was implemented using the best DRaas it will be establishing its recovery at 0.9Gb cost in a day which is equivalent to 0.0104mb per sec, which can be illustrated in the graph below;

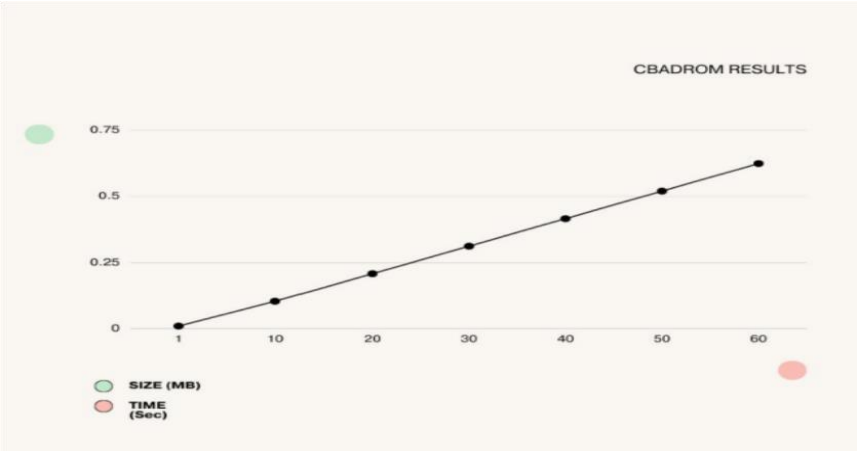

Fig 4. This image shows the RTO of the CBADROM format

Table 1: Study Comparison

Criteria	**Work by Chang Yup Choo & Kwang Sik Chung, South Korea**	**Work done by Omar H Alhazami, Saudi Arabia**
Systems	Core/Context systems	CBADRO M systems
Mechanism used	Mission/Non-mission Critical	Segmentation
Input factors	Core/context mission Critical, Core/Context Non-mission critical	Disaster recovery tier, Cost, Segments, Risk levels
Implementation methods	Analysis systems	Algorithm model
Allocation of RTO/RPO	Mission/Non mission Critical	CRT model used
Built for	Financial organizations	Small/Medium business organizations
Main constraint	Mission/Non mission Critical	Cost
Scope	Disaster recovery & Business continuity	Disaster recovery & Business continuity
Disaster recovery tiers	All applies	All applies
Limitations	Did not consider parameters for RTO/RPO	Did not consider other factors
Internet facilitation	Recovers data in subjection to internet speed.	Recovers data a fraction faster, due to segmenting of storage systems.
Backup strategy	Cloud and incremental backup	Cloud, full and incremental backup

Their performances with respect to RTO/RPO; Each work has advantages and disadvantages which they have in respect to the recovery time objective and recovery point objective, which is the key comparison trait that shows their effectiveness, in ensuring that a disaster recovery system is used to its full potential and reliable in performing its functions and demands, so we are going to show in each work/study how good and effective there RTO/RPO is in the system.

[3]**,** the recovery time objective and recovery point objective , is been initialized with respect to the core/context analysis system which also include the mission critical and non mission critical , whereby by the mission critical segments is selected by business information analysis , which allows then for the recovery time objective to be set and for the recovery point objective to be placed at a point where all the mission critical segments will be recovered after a disaster to that exact point of disaster ,the performance of this system model in relation to the RTO/RPO is exact as the distinguishing of the mission critical and non mission critical allow the disaster recovery system using this system analysis to recover data to the exact RPO / RTO , as the recovery time is met due to ease of identification of important and critical information , and there is minimum data loss.

[13], In this model focuses on cost so it maintains the resources which are been allocated to every segment to maintain the all-out cost so more resources can be spent on regions with more risk and critical levels, this model analyzes the loss impact on an organization meaning how much time does it need to recover and how much data can be lost, it analyzes how the loss impact will be long term, short term, direct and indirect thereby allowing the algorithm to use the input and resources to meet the required RTO/RPO that the organization requires in there disaster recovery system to meet the needs of the organization and make sure the disaster impact is withstood.

Comparisons in	CORE/CONTEXT SYSTEM	CBAD ROM

RTO/RPO		
RTO	Is met only in Core mission critical and non-mission critical factions	Is met in all segments as the CRT analyzes the risk level
RPO	Is met with minimum data loss	It is met at the exact point with almost no data lost

Table 2. This table shows their efficiency in RPO/RTO

4. **Implementation and results**

After all the analysis and comparison structures with a clear effect on which system will benefit the disaster recovery system more and decisively, with every criterion put into consideration and the main effect of the RTO /RPO noted.

Methodology; After all the comparisons and procedures followed, we extracted a systems solution, that will automate the disaster recovery , and initialize an automated process that will constructively, allow for all disaster recovery processes to be performed in the system by using the preference parameters of the backup frequency, and the backup speed which allows for the recovery process, to be seamlessly fast and sufficient to avoid any loss in procedures of any an entire systems or company.

By using the orchestration systems, it arranges the data sort process of coordinating and automating various tasks and activities involved in recovering IT systems and infrastructure after a disaster or disruptive event. also performs the task of management and synchronization of multiple recovery processes to ensure an efficient and effective restoration of operations, allowing for the incubation of all the processes in the layout of a system to be well ordained and aligned to suit the consecutive need of the recovery process, and terms allow for a fast and point disaster recovery, which our majors point of work endeavor is to improve the RPO/RTO of the disaster recovery process to seamlessly improve the transition.

Also by the virtue of using an orchestration system to implore disaster recovery we, used the system to further dynamically improve the cost-effective maintenance system of the disaster recovery process thereby allowing for the user to constructively, recover the systems and lost data in a systems format that will ensure stable procedures of the systems and also enables of cost cutting , and systematic procedures in orchestration allows for the recovery process to follow syntax methods that ill-benefit the user's/companies work in a beneficial environment

4.1 Implementation: An algorithm has been written that will diagnose the impending situation of disaster recovery systems which are repairing a solution too, and carefully not down the fault systems and implications in the which each which each of this steps should be followed in order to impact the disaster recovery for seamless performance in a an industry and companies. Here's a step-by-step algorithmic process for the solution code

4.2 Algorithm: Proposed solution

Input:Backfrequency,speed, maximum downtime,data loss variables,source and destination paths for recovery

Output; Recovery time

1. Define the 'perform_backup' function to initiate the backup process.

2. Print a message indicating the start of the backup process

3. Add your custom backup command within the function.

4. Define the 'perform_recovery' function to initiate the recovery process.

5. Print a message indicating the start of the recovery process.

6. Add your custom recovery command within the function.

7. Define the `calculate_rto` function to calculate the Recovery Time Objective (RTO).

8. For each resource in cloud resources do

9. Take the elapsed time and maximum downtime as parameters.

10. Return the sum of the elapsed time and maximum downtime

11. Define the 'calculate_rpo' function to calculate the Recovery Point Objective (RPO).

12. Take the backup frequency and maximum data loss as parameters.

13. Convert the backup frequency to hours and divide the maximum data loss by it.

14. Return the calculated RPO.

15. Start the main script by printing a message indicating the start of backup orchestration.

16. Enter an infinite loop.

17. Record the start time.

18. Call the ‘perform_backup’ function to initiate the backup process.

19. Record the end time and calculate the elapsed time.

20. Calculate the RTO and RPO based on the elapsed time and defined parameters.

21. Print the completion message with the calculated RTO and RPO.

22. If the elapsed time exceeds the maximum downtime, simulate a disaster and trigger the recovery process.

23. Calculate the sleep time until the next backup cycle by subtracting the elapsed time from the backup frequency.

24. If the sleep time is positive, sleep for that duration. Otherwise, skip sleeping and print a warning message.

25. Repeat the backup cycle indefinitely

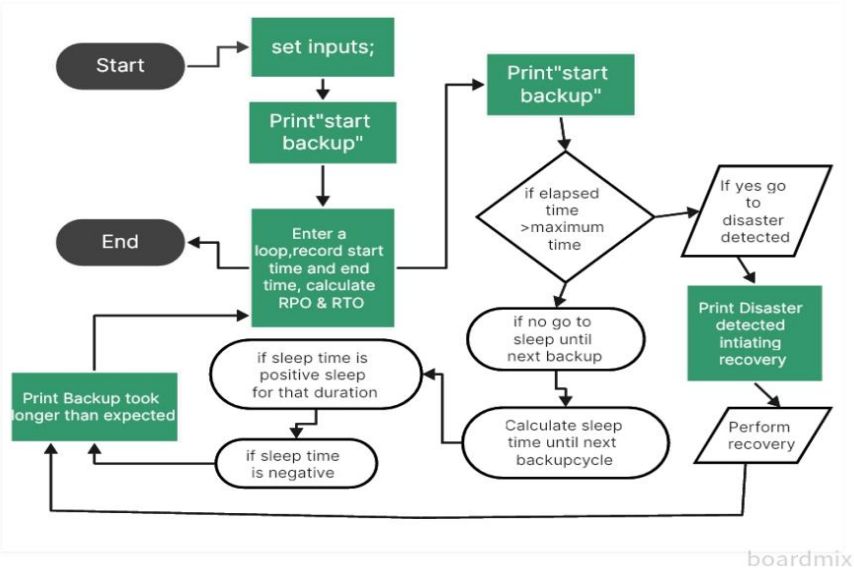

Fig 5: This image shows the algorithm to the solution

4.3 Results: While following the exact algorithmic process above a code was generated using python3 that will automate the disaster recovery segments of the systems , and also illustrate the use of orchestration processes that enhances the functionalities of the automated recovery process and definitely allows for the constructive recovery and backup of systems in an industry , this solution summarized the entire artifacts of knowledge and instruments which was pulled from the various studies and used as a reference to build this intellect of code from the algorithm, to enable a constructive disaster recovery model , and ensure that it mitigates cost and enables to meet the desired RTO/RPO.

The automated disaster recovery shows that in use of the orchestration and our installed parameters, the recovery process was at; 66,961,950.57bytes per sec = 66.96mb per sec equivalent = 67mb per sec as seen in Fig 6

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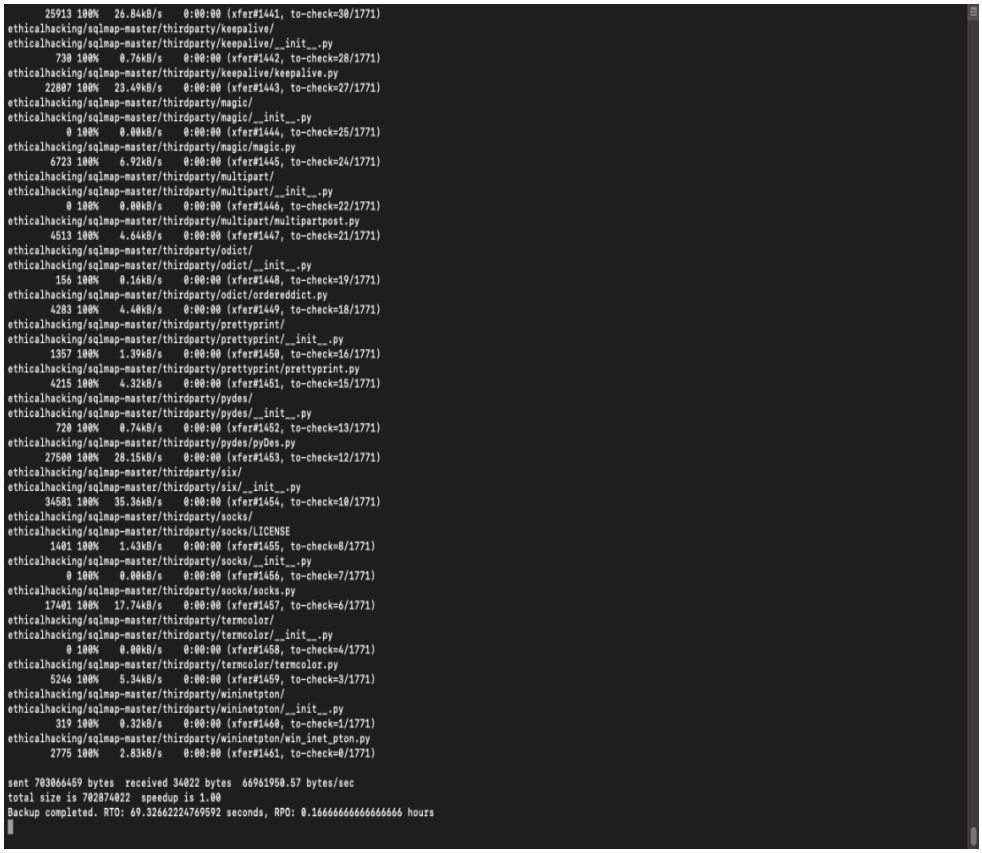

Fig 6. This image shows the results and the speed output

4.4 Graphical representation: A visual representation is been made to show the magnitude of the automated process, and how its more efficient than the studies in comparison, as the parameters for comparison are RTO/RPO which are well aligned in this visual to prove the orchestration and automation efficiency of our algorithm, and how it affects a disaster recovery as shown in Fig 7.

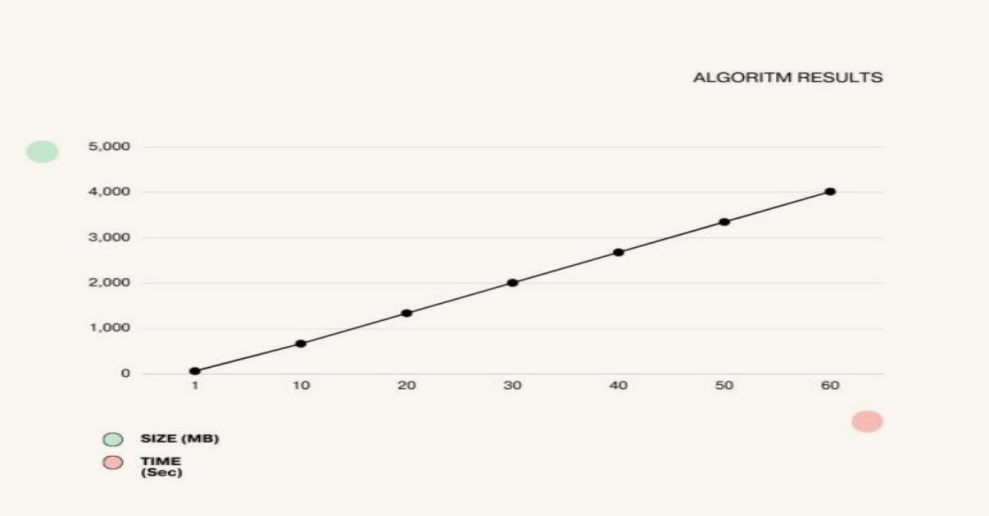

Fig 7. Shows the RTO in the provided algorithm format

5. **Conclusions**

The comparisons we conducted involved distinct criteria that set them apart from each other. These comparisons aimed to provide insights into the diverse systems and algorithms utilized in enhancing the efficiency of disaster recovery processes within organizations. We explored a

range of systems, analyses, and design patterns to identify those that would best serve the organization's needs.

As a result, we developed an algorithm tailored to meet the specific requirements of disaster recovery systems. This algorithm incorporates automation features to facilitate a seamless and well-coordinated disaster recovery process, aligning with backup parameters and speed. Furthermore, we considered various factors to optimize system costs when hosting them in cloud environments, ensuring that these solutions cater to the needs of both individuals and companies. In our research, we have observed that the Recovery Time Objective (RTO) and Recovery Point Objective (RPO) are the primary and most critical determining factors for the effectiveness of a disaster recovery system. These factors remain significant irrespective of the chosen design pattern and should encompass considerations such as criticality, risks, and the importance of specific data when designing a recovery system.

We recommend further investigation into an analytical approach that can consistently meet the RTO/RPO requirements independently of other variables and conditions. Such an approach would ensure the system's key functionality remains operational and enables a seamless recovery process.

Disaster recovery systems are dynamic and have seen various developments and implementations. However, there is room for further refinement to meet the evolving needs of the industry.

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