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Algorithm for Improving the Reliability of Information Resources of the Distributed Cloud Data Center

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ABSTRACT: In the article, to provide reliably saving the information oin the memory disks (in autonomous storage systems) of segments of the distributed cloud data center (DCPC) was purposed. The problem of optimal representation of the data stored in the segments of the DCPC located at different points was formed. As well as, in order to increase the efficiency of providing information to users in the segments of the DCPC, an algorithm was developed to present and place them based on the method of replica to the memory repositories of the autonomous information storage system. In the proposed algorithm, when a physical server or memory space fails, a copy of the data on it is stored in other memory areas of the DCPC and is not lost. When accessed, information is provided from another memory area.

KEY WORDS: Replication, Network, Cloud, Data center,Algorithm, Virtualization.

I. INTRODUCTION

Special technical solutions for storing and processing large amounts of data are used in high-performance servers and data storage systems.Building and maintaining such systems is a complex and costly process. The primary goal of DCPC vendors is to increase revenue by upgrading their existing system at a low cost.
Cloud storage infrastructure is now creating a new architecture that supports different levels of services for a large group of Internet users. This indicates that the problem of allocating information resources in the distributed cloud data center's dislocated databases is becoming an increasingly important task [1,2, 3, 5, 6, 10].

Distributing the information stored in the autonomous cloud data center data storage systems to different parts of the world poses some challenges. Therefore, duplicating data copies may be one of the solutions. It provides the followings:
1. Increases data availability
2. Reduces data access costs
3. Increases data reliability.

However, given the size of data storage systems and limited communication channels in autonomous cloud data centers, this may require additional costs. Therefore, it is necessary to choose the method of replication, taking into account the capabilities of data storage systems in distributed cloud data centers and the bandwidth of communication channels between them.

The paper proposes a replication method for placing information in DCPC storage systems, taking into account the above problems..

II. FORMULATION OF A PROBLEM

Due to the rapid growth of information, the popularity of data storage systems is growing. It is efficient to store them in systems based on cloud technology. In autonomous cloud data centers within a DCPC, the information storage architecture consists of a centralized management system, user terminals, telecommunication network computing resources, and data storage systems (Figure 1). Its main characteristics are given in Table 1.

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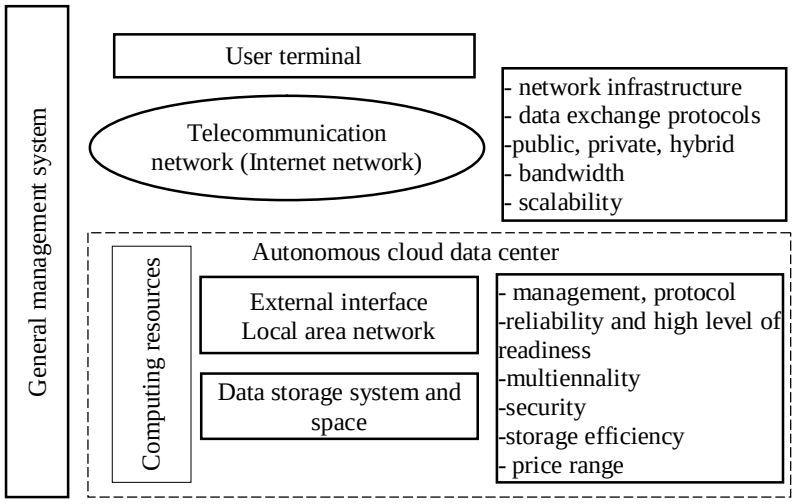

Figure 1. Features of the data storage architecture in autonomous cloud data centers within a distributed cloud data center.

Table 1Characteristics of information storage architecture

Characteristics	Description
Management	Ability to manage the system based on minimal resource conditions and price selection.
Access method	A protocol that provides cloud storage information.
Reliability and high level of readiness	It is characterized by continuous operation time of the system
Information storage efficiency.	It is determined on the basis of an indicator that determines the efficiency of the system

Each autonomous cloud data center within a distributed cloud data center has its own data storage systems. When access to the central management system of the cloud data center distributed to the memory disks is required, the autonomous cloud data center is connected to the storage systems through the external interface and access to the information on the disk is provided.

In recent years, virtualization of storage systems to disk resources has begun. In this case, one side of the virtualization tool is connected to disk media, and the other - to server computers using a network. The virtualization tool contains rules for converting physical memory resources into virtual resources managed by server computers. After all, server computers use virtualization tools to see only resources, not storage media.

The information stored and planned to be stored on the disks of the dislocated autonomous cloud data centers within the DCPC differs significantly in value and content. Demand for this specialty has grown significantly as a result of recent corporate scandals. This results in higher loads on some autonomous data centers within the distributed cloud data center and on the same sections of the telecommunications network, while others have lower loads. Therefore, it is important to ensure that the autonomous cloud data center within the DCPC reliably stores information of various contents and provides fast and high-quality information in accordance with the request [8, 9].

One solution is to use replication techniques. Replication is the process of copying information from one storage location to another and then synchronizing its contents in distributed systems.

A common way to ensure the reliability of information storage and the functional stability of servers is to back up these databases. When data is lost from memory for a variety of reasons, having a backup allows you to quickly restore the database. The information stored in the distributed cloud data center segments should be delivered to the users as soon as possible. In some segments of distributed cloud data centers, the information stored may be located at a great

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distance from the central management system (CMS), or the data transmission capacity of the network media (communication channels) between the information storage segment and the central management system may be low. It takes a lot of time to provide the information required by the request.

III. THE SOLUTION OF THE PROBLEM

The following is a description of the algorithm for repositioning distributed cloud data center memory repositories to ensure the reliability of information storage processes in distributed cloud data center segments and increase the efficiency of providing information to a wide range of users (Figure 2).

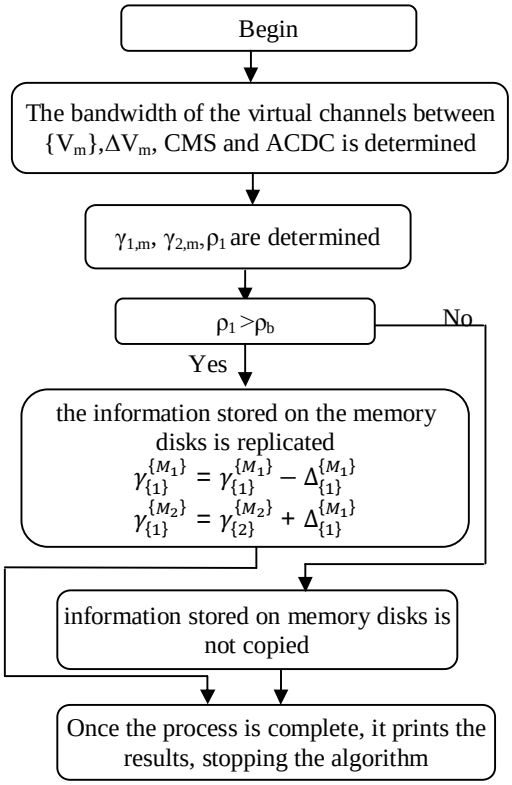

Figure 2. Algorithm for increasing the reliability of distributed cloud data center information resources.

The following information will be determined first
- The amount of information of different types and contents stored in the memory repositories of the autonomous centers within the distributed cloud data center {V_m};
- distributed cloud data center Unused portion of data storage in autonomous cloud data centers {ΔV_m};
- the bandwidth of virtual channels between the central management server and the autonomous centers is determined, the value of which is expressed in the form of the queue service intensity parameter μ_m (m = 1.2,…, M).

The intensity of requests to the central management server of the cloud data center, distributed to the information stored in the memory warehouses of the autonomous cloud data centers, is determined by $\gamma_{1,m}$, based on their analysis of the virtual channels of the telecommunications network and the value of the intensity of the ridges is $\gamma_{2,m}$, m and their loading degree is $\rho_1=\gamma_{1m}/\mu_{1m}$,$\rho_2=\gamma_{2m}/\mu_{2m}$. Since the volume of information requests at the input of the virtual channel and memory disks is approximately the same, and the processing speed of computer memory disks is several times faster than the virtual channel data transfer rate, the expected result can be achieved by performing the replication process based only onρ_1. will be possible.

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3. A certain threshold value of the load level of the virtual channel is set $\rho_{1,ch}$, on the basis of which the autonomous cloud data centers within the distributed cloud data center are divided into 2 sets:
- $\{M_1\}$- $\{\rho_1\} > \rho_b$the number of autonomous cloud data center packages $\{M_1 \subset M\}$ that fulfill the condition that the information stored on their memory disks is replicated;
-$\{M_2\}$-$\{\rho_1\} <= \rho_b$the number of autonomous cloud data center packages that meet the condition $\{M_2 \subset M\}$, the information stored on their memory disks is not replicated, $M=\{M_1\}+\{M_2\}$.

4. Based on the above, the autonomous cloud data center in the packages $\{M_1\}$ and $\{\{M_2\}$ are arranged according to the value of the loads at the input of the centers, i.e. $\rho_{1,\{1\}} > \rho_{1,\{2\}} > \ldots > \rho_{1,\{M1\}}$ and $\rho_{1,\{1\}} > \rho_{1,\{2\}} > \ldots > \rho_{1,\{M2\}}$, {M2} and $\{M_1\}$The replication process is performed from the largest loaded autonomous cloud data center: The smallest loaded autonomous cloud data center in the {M2} package writes a copy of the information stored in the largest loaded autonomous cloud data center in the {M1} package, and a certain part of the stream directed to it {M2} the smallest load in the package is routed to an autonomous cloud data center, namely:

$$\begin{aligned} \gamma_{\{1\}}^{\{M_1\}} &= \gamma_{\{1\}}^{\{M_1\}} - \Delta_{\{1\}}^{\{M_1\}} \\ \gamma_{\{1\}}^{\{M_2\}} &= \gamma_{\{2\}}^{\{M_2\}} + \Delta_{\{1\}}^{\{M_1\}} \end{aligned} \quad (1)$$

Where $\Delta_{\{1\}}^{\{M1\}}$is the portion of the flow directed to the autonomous cloud data center in the set $\{M_1\}$ that is transferred to the autonomous cloud data center in the set $\{M_2\}$;
{1} index is the serial number of the autonomous cloud data center in the set $\{M_1\}$ where the information being copied is stored;
Index {2} is the ABMM sequence number in the set $\{M_2\}$ being copied.

IV. EXPERIMENTAL RESULTS

The autonomous cloud data centers in the experience-distributed cloud data center structure were conducted only in the case of memory resources. Information resources of different types and values stored in them are provided in a centralized and autonomous manner. There are 3 types of information resources stored in the memory areas of autonomous cloud data centers:
open type media;
specific information about a particular company;
confidential information.

The storage and submission of the second and third types of information are subject to security measures. Their size and which autonomous cloud data centers are stored in the distributed cloud data center management system and administration are known. Most users are interested in open source information, so the intensity of their requests is slightly higher than the intensity of requests for other types of information. Therefore, the pilot process was mainly focused on providing general information [4, 7, 11].

Requests with the intensity of access to the central control system of the distributed cloud data centerare distributed at different intensities to the information stored in the memory areas of 13 autonomous cloud data centers (Figure 3).

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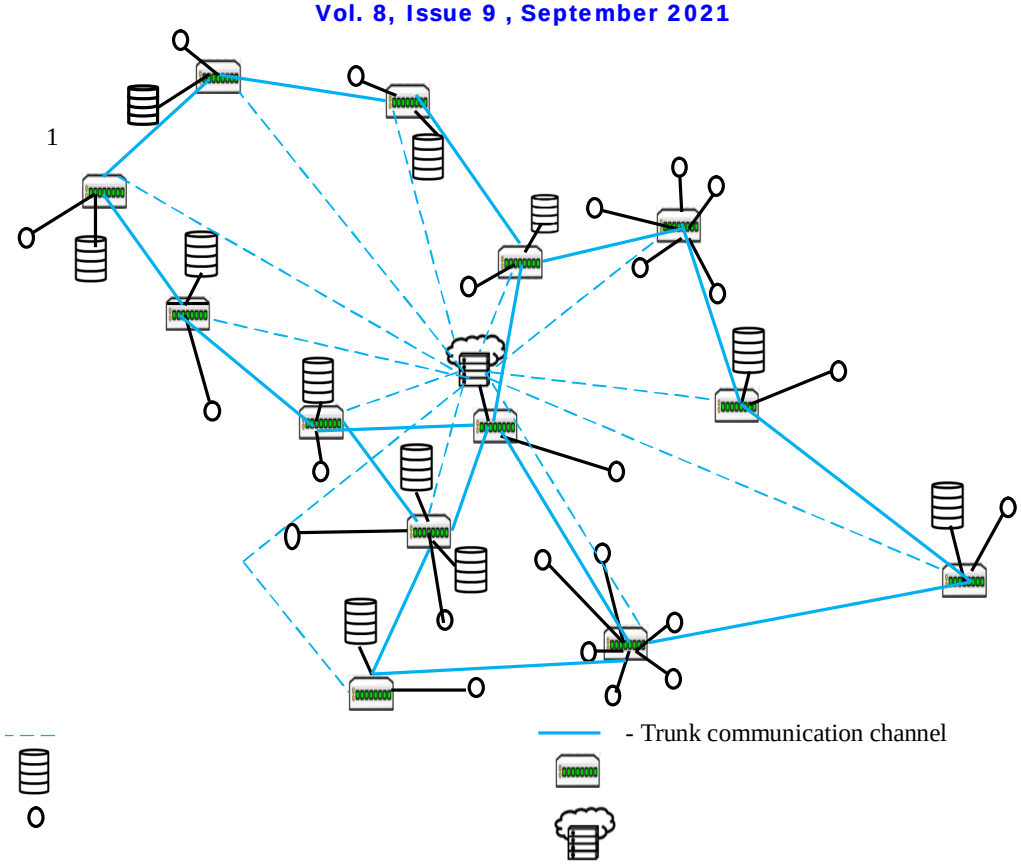

Figure 3. Structure of a distributed cloud data center telecommunications network.

The demand for information stored in the memory areas of autonomous cloud data centers is defined as higher than others, and the process of servicing requests is modeled in two cases - directly and on the basis of the proposed method of replication in the workplace, the results are shown in Figure 4**.**

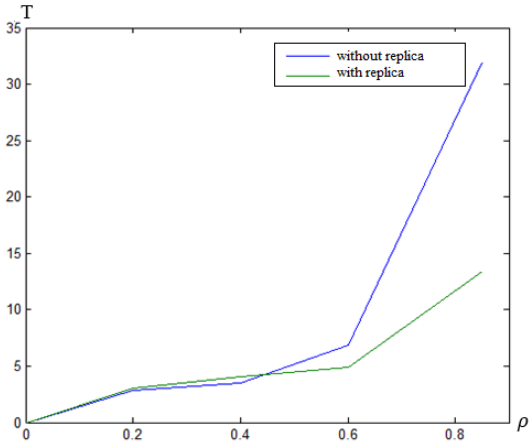

Figure 4. A diagram showing the effectiveness of a distributed cloud data center in providing information resources based on the replication method.

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When the system load level was relatively low (0.1–0.5), the total time T of the requests in the system remained almost unchanged. When the load is higher than 0.6 (especially $\rho \geq 0{,}8$) the installation of copies of information resources in low-load autonomous cloud data centers and the optimal distribution of requests can reduce the average cost of service for requests.

V. CONCLUSION

Summarizing the above,it can be said that over time, the value of requests that require information resources to the central government system may change.

The use of replication methods is effective in the optimal presentation of the data stored in the autonomous cloud data center memory warehouses within the distributed cloud data center. At the same time, replication leads to an increase in the reliability of information. When a physical server or memory space fails, a copy of the data on it is stored in other memory areas of the distributed cloud data center and is not lost, and when accessed, the data is provided from another memory area.

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