Application of Hybrid Technologies for Long-Term and Reliable Storage of Digital Information

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Abstract: The problem of long-term storage of digital data, provides methods and technologies for reliable data storage is considered in the article. The concept of "information technology" is considered. In addition, the components of information technologies are given and a block diagram of these technologies is formed. Also, considerable attention is paid to data storage systems. The requirements that apply to systems for reliable storage of the necessary information are considered. At the same time, technologies and data storage devices are being explored. An analysis of the use of data transmission technologies has been carried out, features and shortcomings have been identified. Modern information processing technologies that are used to analyze and manage data at various enterprises are considered. A hybrid system, which makes it possible to store digital information for a long time and reliably is presented.

1 INTRODUCTION

The relevance of the work lies in the fact that most of the population receives and transmits some amount of necessary information daily. There is a huge amount of information technologies for the transmission, storage and processing of data. However, for the further development of a reliable and high-speed data transmission channel, it is necessary to apply modern technologies. In order to do it, it is necessary to constantly analyze various methods for collecting, storing and reproducing information. In addition, technologies make it possible to analyze a large amount of data, store it securely and transmit information over long distances. Thus, information technologies have a great development potential in our country.

In order to ensure high-speed transmission of information, it is necessary to use special networks and data transmission channels. Information technologies for information transmission include software and hardware that form the connection of channels between subscribers of the line, in addition, they are required to provide reliable, high-speed and interference-free data transmission (Grigoriev, 2021).

Information technology is a set of operations for the collection, storage, processing and transmission of data using software and technological tools.

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Figure 1: Structural diagram of information technology.

2 PROBLEM STATEMENT

The main task of information technology is to implement the reliability of data storage for further transformation and analysis.

Every enterprise faces the problem of reliable data storage. This situation arises with an increase in the volume of necessary information and with an increase in the mandatory conditions for protecting the data used (Proshin, 2010). Modern systems and technologies for information transmission are a hardware and software set of equipment, which is developed taking into account customer requirements.

The data storage system (DSS) consists of a set of specialized equipment that is used to store information at various stages of the transmission channel. The following requirements are imposed on the storage system: it must be flexible, scalable, and fault-tolerant, and it must also comply with security requirements in the information area.

3 RESEARCH QUESTIONS

Storage technologies include RAID technology (Redundant array of independent disks). It is a technology that makes it possible to implement data virtualization, and combines a certain number of disks in logical elements to increase the performance level (Kochetova, 2022). Storage technologies are divided into two types:

1. hardware RAID that is used in a system that uses at least four drives. For its' implementation, it is necessary to purchase the material and technical part of the computer with an additional processor and its own memory;

2. software RAID that is used in a system with a small number of drives. For its' implementation, controllers on the material board that do not have their own memory and additional processor are required.

At the moment, there are a large number of storage devices, here are some of them:

– DAS drive - is embedded in the server to acquire additional space with relatively high-speed access. It is easy to operate and inexpensive;

– NAS storage – it is connected over the network, has centralized management. It has a major drawback - the access speed is limited by the network speed;

– SAN storage – it is connected via fiber optic cable. It has high access speed.

Data transmission technology is a set of means and equipment for information transmission (Vladimirov, 2015).

4 MATERIALS AND METHODS

Let us analyze the existing data transfer technologies:

1. The fastest technology is the wireless transmission technology using light swirls, which has a transmission rate of 320 GB/s. The implementation of the system is contained in the following: electromagnetic waves are a channel for transmitting information that spin the vortices in the intended form. Moreover, the number of information flows is not limited within the wave. Thus, a large amount of information can be transmitted at very high speeds. The technology uses orbital momentum, which is more technologically advanced than the angular momentum used in Wi-Fi and LTE transmission channels. The light vortex system is used in fiber optic cables. However, this technology has a significant drawback - today it is at the development stage, therefore, all the advantages of the application have not been studied;

2. The most powerful wireless transmission technology is the use of neutrino beams, which have the ability to transmit a signal through objects. Charges of neutrino rays pass through objects without interacting with the material. Scientists from the United States have been able to transmit a signal through a stone with a length of two hundred and forty meters. None of the existing data transmission technologies has this ability. The bottom line is this: the charges of neutrino rays are accelerated to the speed of light, due to which they acquire the ability to pass through the material. The development of this direction is promising, as it allows you to transfer data over ultra-long distances and to hard-to-reach places. However, the technology has several drawbacks - at the moment, equipment for transmitting neutrino beams is expensive, and this system also requires a powerful particle accelerator;

3. The most unusual technology is RedTacton , which consists in the use of the outer cover of a person (Sarycheva, 2022). The essence of the technology: any person generates an electromagnetic field, and the outer cover is used as a data transmission channel between devices. This

technology uses electro-optical crystals, the properties of which change under the influence of the electromagnetic field of people. The laser reads the changes in the crystals and translates them into a format that is easy to use. The system can be used in various conditions, in space, under water, in vacuum. Further development of this technology is promising, because it allows communication without the use of wires. There is one drawback - the technology has not been fully studied.

5 RESULTS

Modern technologies for data processing are shown in Figure 2.

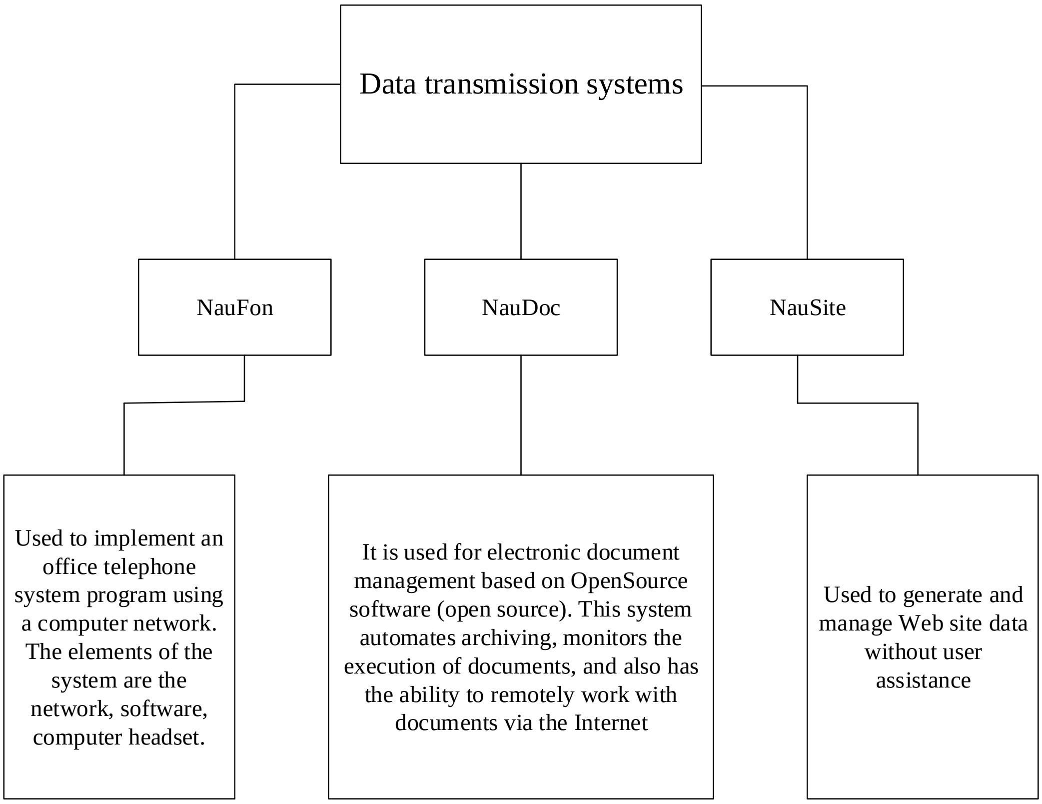


Figure 2: Types of data transmission systems.

Systems that are built in the client-server architecture and use modern equipment are modern technologies. For example, NauFon, NauDoc and NauSite. These systems are used to process and manage data in various enterprises (Kukushkin, 2022; Yumashev, Koneva, Borodina, Lipson, Nedosugova, 2019; Chirkov, Chistyakov, 2019).

The NauDoc system is used for electronic document management based on OpenSource software (open source texts). This system automates archiving, controls the execution of documents, and also has the ability to work remotely with documents via the Internet. The main functions of the system:

1. formation of a document using the built-in editor. For each document, the system creates a standard set of categories that determine the status of the document. A separate category contains a set of details that can be changed to form new categories, for example, creation date, title, author;

2. job scheduling with periodic time. Each individual task is created automatically after a certain time, for example, a monthly report;

3. receiving notification of events - receiving letters from the mail, intra-corporate announcements. Notifications can come not only to a computer, but also to a cell and home phone, as well as to personal email;

4. search for documents by various categories, such as attributes, body text, date, author;

5. transfer of documents for long-term storage (archiving) - the generated documents can be archived, thereby transferred to the invisible zone of the user. However, the user has the ability to restore documents at any time.

6 FINDINGS

The NauSite system is used to generate and manage Web site data without user assistance (Glasman, 2020). Main functions:

1. formation of corrections to documents for subsequent publication on the site. Images can be added to the source document, the images themselves are located on the server, and the link to the image is indicated in the document. The server MAY output a 1:1 scale image link if the original image's scale is unreadable;
2. compiling sections on the site - each section has a link with a folder tree. And to form a new section, a separate folder is created. Also sections, folders and contents of documents can be changed;
3. maintaining the functioning of a large number of Web sites - sites are managed through one interface. It is possible to copy and move documents between sites;
4. a site map is automatically generated. When generating, a site page is created with a tree of sections and folders;
5. the ability to search for documents by various criteria - by details, by the main content of the documents.

The NauFon system is used to implement the office telephone system program using a computer network (Glasman, 2020; Zhukovskyy, Printz, Zhukovska, Hubach, Rajab, 2021; Zolkin, Domracheva, Losev, Avdeev, 2021). The elements of the system are network, software, computer headset. Features of this system:

1. operational formation of teleconferences with control through any computer;
2. call redirection - if the employee being called is busy, the call will be redirected to a free employee. Also, if a landline is busy, the call will be sent to the nearest to the desired employee, if the employee's route is known;
3. integration of applications for customer service - if the system determines the number of the customer, then a program will be automatically launched on the employee's computer, allowing you to see the current state of affairs.

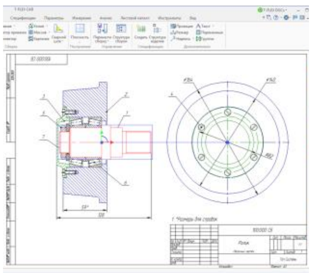
7 DISCUSSION

The main problem of long-term storage of digital data, as well as providing quick access to the necessary volumes of information, is best solved using hybrid technologies, for example, COM technology (Computer Output Microfilm), which has beencreated on the basis of microfilm (Rothenshtein, 2012; Lavrov, Pasko, 2018).

The hybrid system includes the possibilities of microfilming and scanning, which allows you to transfer paper documentation to an electronic format with quick access to this information (using non-formalized information from computers) and use the micrographic form that is required to ensure safety, thus creating two types of archives: micrographic and digital. While saving time and effort, secure storage of information is provided, which eliminates obsolescence of equipment and changes in media formats.

Although some data (photos, paintings, etc.), which may contain an abundance of small but important elements (technical spare parts, parts) when printed on microphotographic carriers or scanned with microfilm, require additional costs for operators to render or will contain inaccuracies in the reproduced format (Borodko, Kukunin, 2013).

The way to solve such a problem is the image of binary information (i.e. binary code) on a microphotographic carrier (Figure 3).



Drawing in CAD application

0000000000011100
1000000100000110
1100001100000011
1111111100000011
1101101100000011
1111111100000011
1111111111111110
0111111011111110
0001100011000110
0000000011000110
0000000111001110
0000000111001110

Converting a drawing to binary code

Figure 3: Reproduction of binary data (binary code) of the original.

To implement the automation of production processes and reduce the area of bit information, this information is encoded using specialized software (generators), then output in the form of a two-dimensional code on a microphotographic carrier.

At the moment, the most common type of two-dimensional barcode is Aztec. This barcode allows you to highlight the required data area and the target area. The target, in turn, consists of a set of squares in a concentric form. The target makes it possible to determine the geometric center of the symbols during decoding.

8 CONCLUSION

In conclusion, it shall be noted that currently operated large-volume digital data storage systems cannot guarantee the long-term and safe storage of data that has beenrecorded more than five years ago. However, the improvement of hybrid technologies (COM technologies) created on the basis of microfilming opens up the possibility of long-term and reliable storage of digital information in analog form. Methods for storing digital data on microfilm show the latest methods, consisting in the fact that for the first time they have been able to theoretically substantiate and technologically realize the possibility of long-term storage of any digital data and documents on microfilm. In this storage method, all digital information consists of a binary code and can be displayed in the form of two-dimensional graphic barcodes. In addition to storing digital color and black-and-white, drawing-graphic, text and photographic documentation, the use of this method allows opening up the prospects for storing software products, digital audiovisual documentation, as well as three-dimensional documentation of CAD applications, etc. on microfilm. This means that there is a possibility save any type of digital information. As a result, this storage method contributes to a significant approach to solving the issue of long-term storage of digital information while reducing labor intensity.

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