

## Cloud managers – an innovative approach to the management of the library information resources

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*Abstract.* The innovation of application of cloud managers is described in the article. The authors emphasize that the innovative direction of development of information activities is the integration of Web platforms (social networks and cloud storages) for creating a unified communication space and storage for large amount of information. Tool that provides this development are cloud managers. For library institutions using such technologies will create the favorable and flexible service-oriented system for providing users with information resources. For determination of free cloud managers and selected among them a benchmark, the methods of benchmarking and expert evaluation were used in the research. The algorithm for operation with every service is given. The following technological capabilities: “integration with cloud storage”, “cloud disk space manager”, “multimedia playback,” “presence of workspace” for collaboration were taken into account. The result of the study is to determine the cloud manager that can serve as a benchmark for providing free cloud services with a wide range of technological capabilities.

*Key words:* library, service, cloud storage, cloud manager, service-oriented system, benchmarking, information resources, user, expert evaluation method.

### INTRODUCTION

The cloud storages have passed the stage of closed repositories that provided services to individuals [1]. The amount of space and interoperability today has lost priority when their characteristics are presented. The cloud managers as innovative tool for management and accumulation of information resources has been investigated.

### THE ANALYSIS OF RECENT RESEARCHES AND PUBLICATIONS

In the last years, cloud technologies increasingly come to the attention of foreign researchers of librarianship. We can partially agree with L. Alyoshin [2], which states that unified logical architecture of the electronic information space based on Internet information environment can be called information cloud, and methods and tools used inside – the cloud technologies.

Service-oriented architecture defines the way of design, integration and services management in the information environment. Using this approach assumes that the application is designed as a set of services. The building of applications is done by combining existing services. The service-oriented architecture assumes three main participants: service provider, consumer and register of services [3].

On the basis of that architecture the service-oriented systems are formed. Nandkishor Gosavi, Seetal S. Shinde, Bhagyashree Dhakulkar consider the cloud technologies as service-oriented systems, consisting of various information services. Most of these services are independent from each other, united in a single system. This, according to the opinion of the researchers, allows re-use the services, without additional forming response to the request [4].

The virtual technologies and libraries management that dispose own information resources in the “clouds” were considered in the paper Sangeeta N. Dhamdhare [94]. The study presents the results of implementing cloud services in Orissa academic library in India. M. Monirul Islam justifies necessity of implementing cloud technologies for building digital library in Bangladesh. The possibility of cooperation between the existing electronic libraries in Bangladesh for unified information space is considered. At the same time, the ways of removing barriers that arised with implementing cloud services technologies are analyzed. The researcher analyzed the use of cloud services in many libraries in the world: Congress, Exlibris, Polaris, Scribd, Discovery Service, Google Docs / Google Scholar, WorldCat, Encore [5]. The district of Columbia Public Library uses service Amazon EC2 (Elastic Computing Cloud) for hosting its website.

A well-known expert in the field of computer technology M. Avetisov made an overview of trends in the development of cloud services in his video presentation:

“Cloud computing for libraries”, offering to use cloud library information systems (CLIS) instead of automatic library information systems (ALIS) [6].

Matt Goldner [7] investigated the advantages of using cloud services in the libraries in three main areas: technology, information and community.

P. Sasikala [8] defined the concept of cloud services as innovative technology, service and accessibility of the clouds for the government, businesses, universities, library institutions.

In 2016 the Verkhovna Rada of Ukraine approved a bill introducing the concept of the system “cloud” computing and “provider” of the cloud services and the use of their services for authorities.

The head of department on work with educational and science institutions of “Microsoft Ukraine” company O. Sviridenko, introduced a presentation: “Microsoft products in the library information service system”, where the possibilities of cloud service Microsoft – Office 365 are analyzed, convincing in its ability through a combination of education and information technology to improve the effectiveness of cooperation, communication of teachers and students [9], to provide a new level of training.

Curtis Bonk – the professor of Indiana University, lecturer of psychology and technology of education, expressed the right opinion: “...the network cloud opens the door to a world of knowledge for those who are unable to study the traditional way: the elderly, the disabled, those who work abroad...” [10].

## OBJECTIVES

The article aim is to determine the free cloud manager which would allow to create an innovative information system, focused on improving library users service.

## THE MAIN RESULTS OF THE RESEARCH

The use of cloud managers for document management in the “clouds” has not yet been researched by library professionals. The use of cloud managers will improve the effectiveness of library users information support.

A library is an integrative social institute, as well as the library science must be diverse, that caused a choice of research methods [11].

Through our study the most universal cloud manager providing free of charge services and could be used in the libraries was defined with benchmarking methodology.

Benchmarking – is the part of a systematic and structured approach to search and implementing the best examples of excellence. In the library the benchmarking studies can be used to compare one service to others.

Firstly, the concept of benchmarking was investigated by western scientists: V. Brukhard [12], R. Venetuchchi [13], G. Watson [14], R. Kemp [15], T. Furey [16], W. Krokovski [17], D. Leidig [18], J. Shetty [19]. Among the Russian – I. Aryenkov [20], O. Arefyeva and O. Arefyev [21], G. Bagiev [22], O. Mikhailova [23], Yu. Solovyova [24]. This problem was investigated by Ukrainian researchers: L. Dougan and V. Nemtsov [25], O. Podsolonko [26], K. Redchenko [27], O. Tereshchenko [28], Z. Shershneva [29]. Among the researchers suggested to use benchmarking in the context of librarianship, worth noting: F. Wilson [30], S. Town [31], C. Creaser [32], P. Brophy [33], A. Okladnikova [34], A. Zemskov [35], N. Permitina [36], I. Davydova [37].

However, the benchmarking concept for researching library services, first comprehensively was described in papers [38; 39].

Before carry out a comparative analysis, let’s consider the functional capabilities of the studied cloud managers.

**1. Mover** – on-line file manager. It is designed exclusively for sharing files between cloud storages and does not imply a joint space and sharing documents.

The algorithm of sharing files between cloud storages consists of the following steps:

1. To choose the cloud storage from which you need to transport files, previously synchronizing with your Mover account.
2. To choose the cloud storage to which files are transported, previously following the synchronization of the accounts (Fig. 1).
3. To choose the files and confirm the transfer.

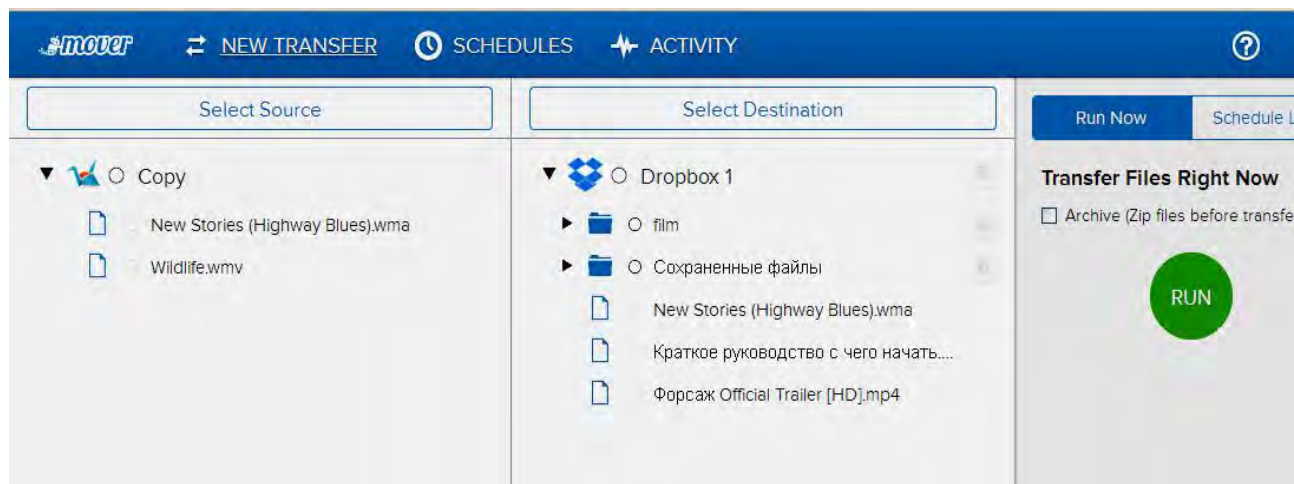


Fig. 1. Mover workspace interface

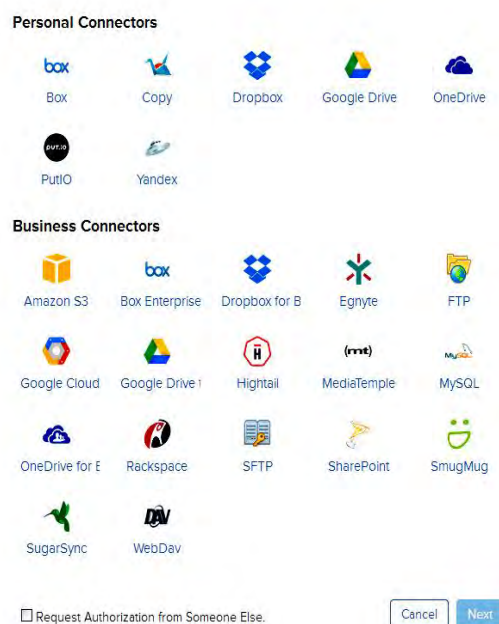


Fig. 2. The library of acceptable cloud storages for integration with Mover

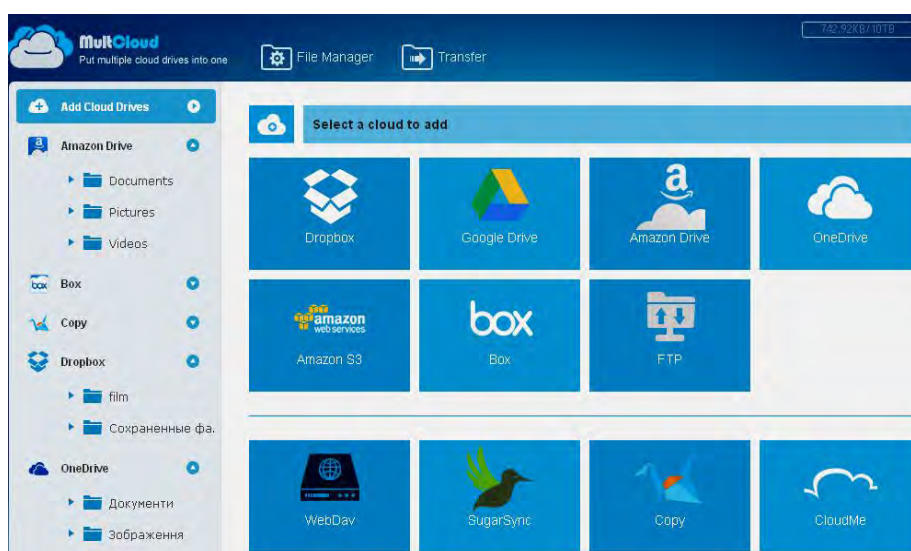


Fig. 3. Multcloud file manager interface

Web-service Mover provides interaction between 5 cloud storages: Box, Dropbox, Google Drive, Yandex. Drive, OneDrive (Fig. 2).

2. Disk space of the cloud manager **Multcloud** reaches 10 terabytes and can store documents submitted from computer and send them to any cloud storage. Multcloud functional capabilities provide file-sharing via email, through social networks: Twitter, Google+, Tumblr, Facebook, LinkedIn. However, the service has a number of disadvantages. It does not provide review of multimedia files, grouping files by category, presenting them in a directory.

The cloud manager Multcloud is able to transfer the documents between 5 cloud storages: Box, Dropbox, Google, DriveOneDrive, AmazonDrive (Fig. 3).

1. To choose two cloud storages. The sharing between them will be done without synchronizing of their accounts.

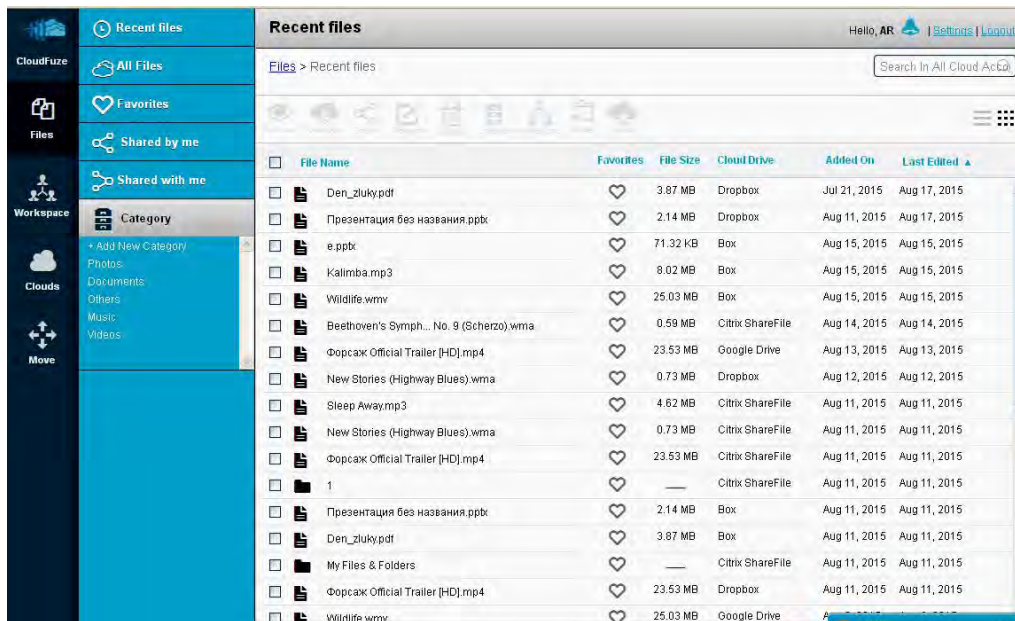
2. To determine the source folder of files to transfer.

3. To choose the folder for imported documents or create a new one. Among the disadvantages is transferring the files with the whole folder.

3. The Web-service **CloudFuze** operates for a fee, but provides test access. CloudFuze cloud manager environment provides easy file search, dividing them into categories:

- other,
- documents,
- images,
- audio files,
- video files.

However, the transfer of the files between categories is possible. The service functionality is enhanced with the ability of searching files in the general directory (Fig. 4).



**Fig. 4.** CloudFuze general directory of files. CloudFuze environment allows to view files of any type, except video. CloudFuze environment provides file sharing without uploading to the cloud manager



**Fig. 5.** The library of acceptable cloud storages for integration with CloudFuze

This cloud manager consolidates 6 cloud storages: Box, Dropbox, GoogleDrive, OneDrive, Egnyte, Yandex.Drive (Fig. 5).

The functional capabilities of CloudFuze include total control of disk space as well as distributed for cloud storages (Fig. 6).

The Web-service provides files sharing for team work with them (Fig. 7).

The algorithm of files exchange between cloud storage integrated in SloudFuze is:

1. to choose the Cloud Storage document storage (Fig. 8).
2. To choose a file to move.
3. To choose the folder location for storing the documents.

4. To make a move.

4. Web-service **ZeroPC** is designed to integrate Web-applications in one convenient shell.

ZeroPC service integrates with accounts of postal services, social networks, cloud storages (Fig. 9).

Free disk space of ZeroPC without connecting with the cloud storages is only 1GB. ZeroPC provides file sharing between 8 cloud storages: Google Drive, Box, Amazon Cloud Drive, Dropbox, Evernote, OneDrive, 4shared, Yandex.Drive and 4 social networks: Facebook, Twitter, Instagram, Flickr.

The unified space of connected services form a single drive ZeroPC, where the files are grouped by categories (Fig. 10): text documents, images, music, video, the recently added files.

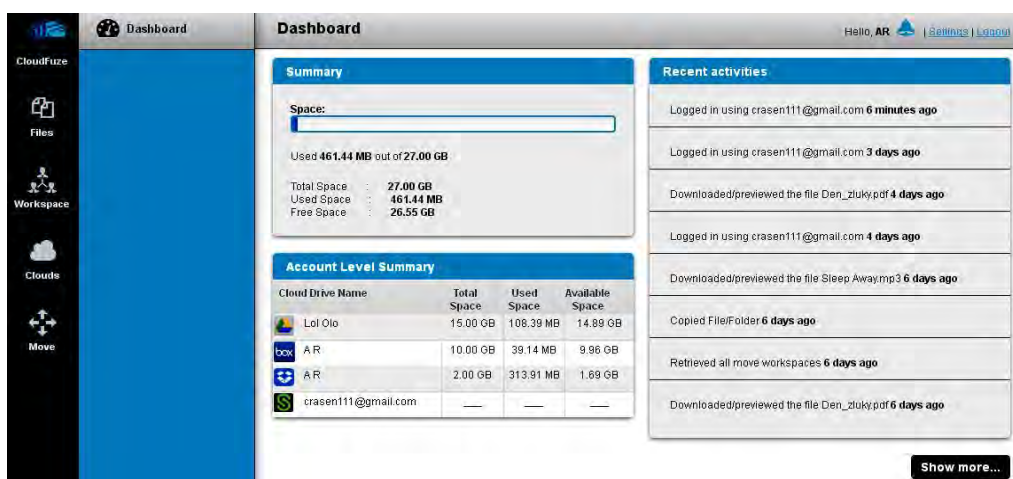


Fig. 6. CloudFuze Dashboard interface

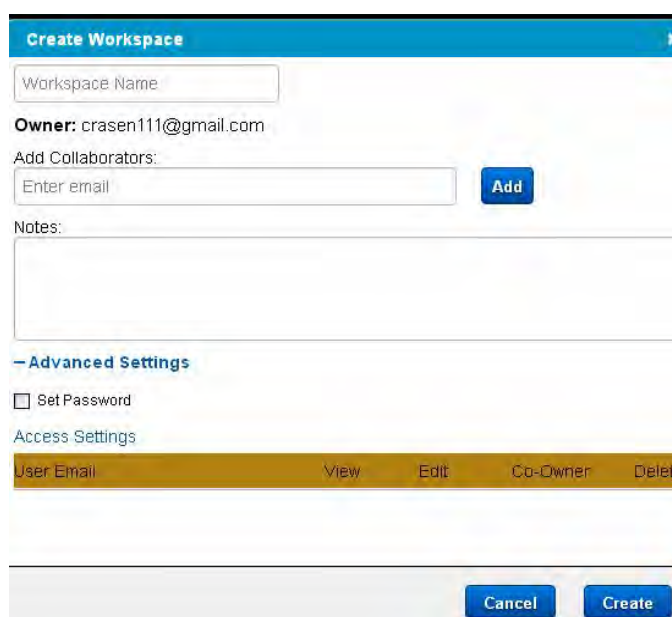


Fig. 7. The bookmark “Create a workspace” in the cloud manager CloudFuze

It provides easy file management: delete, copy, move between folders. The advantage of the service is the ability to view multimedia documents and work with multiple files of different types at the same time, providing of detailed analytics on:

- storages, integrated into ZeroPC and formed space;
- the quantitative filling each cloud storage;
- the substantive content of each cloud storage.

The comparative analysis of the cloud managers functional capabilities to identify the most optimal one to control the document flows, saved in the cloud storages, has been used (Fig. 11).

According to the comparative analysis of the cloud managers, covering a wide range of cloud storages, are marked: Mover and ZeroPC. However, the platform Mover significantly inferior to ZeroPC in other parameters. The cloud manager ZeroPC integrates the largest number of cloud services. The ability to use a definite starter space available for cloud managers Multcloud and CloudFuze. CloudFuze stands out as the

only cloud manager that provides the ability of mutual work with documents.

The extending of cloud manager starter space achieved by integrating multiple cloud storages. The leader in this process is cloud manager Multcloud.

The playback of multimedia products is possible only in the environment of ZeroPC. Thus, the leader is considered the cloud manager ZeroPC. With the expert estimation method based on the given set of criteria, the received results were verified. The comparison of cloud managers based on the weights of alternatives, determined by several experts.

Let's concisely analyze the received results. Analyzing the criteria for selecting services, the emphasis was on opportunity to extend the virtual space for preserving information resources with the integration of cloud storages. The comparison of the cloud services is made according to the criteria: “cloud storages integration”, “amount of space”, “multimedia playback”, “mutual workspace”.

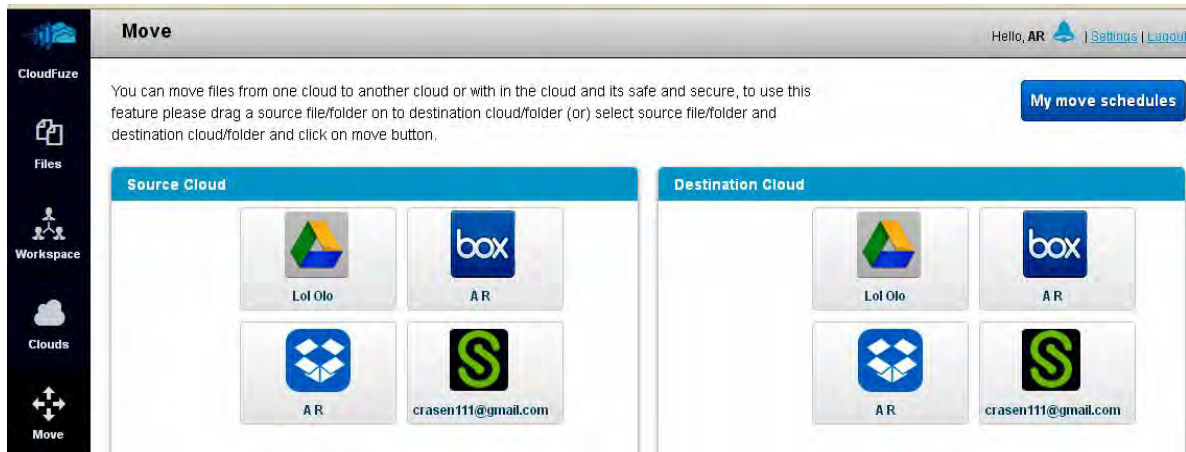


Fig. 8. The bookmark “Move files” of the cloud manager CloudFuzeOne of the advantages of the service is the ability to view the history of moving files from the beginning of the account creation

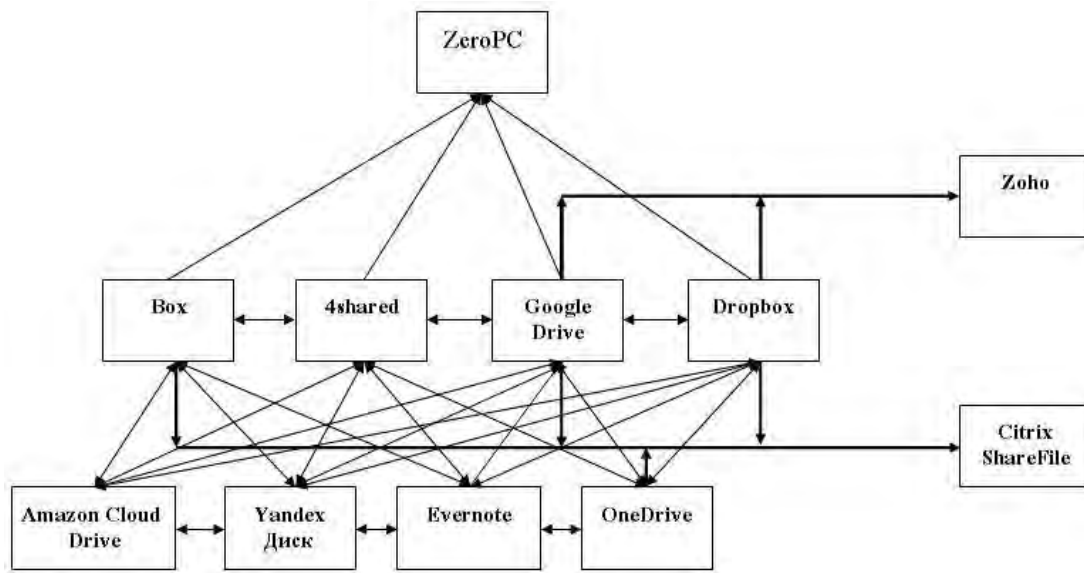


Fig. 9. The scheme of cloud storages integration via the cloud manager ZeroPC

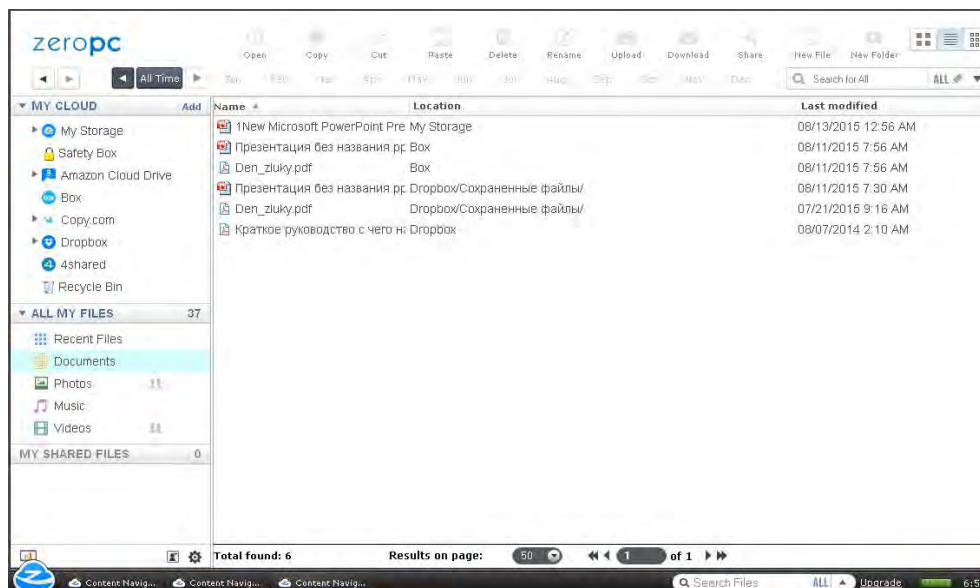


Fig. 10. Browsing files by categories

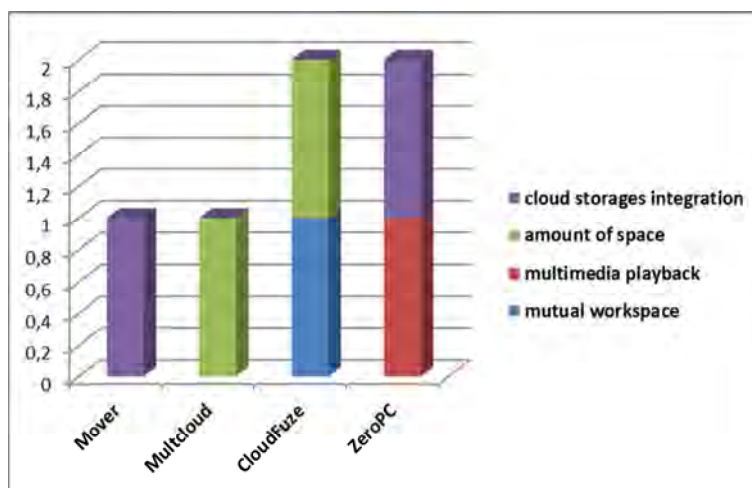


Fig. 11. The results of the comparative analysis of cloud manager

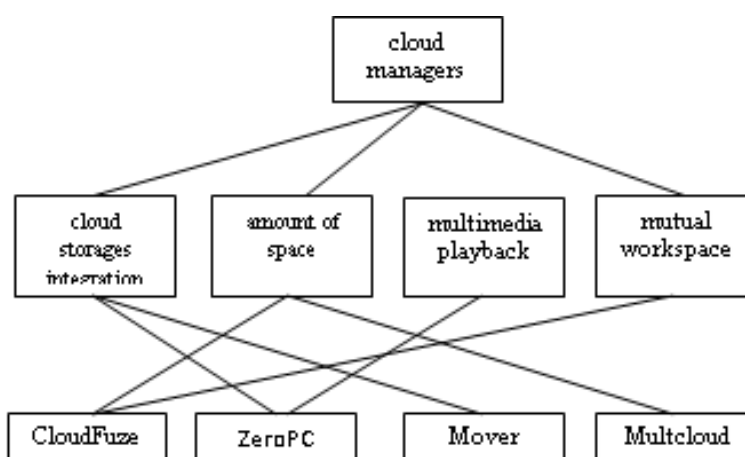


Fig. 12. The structure of the decision-making problem by hierarchy analysis method for choosing cloud manager for the library service of the users

The analysis of the set of alternative platforms and criteria allowed to draw up the hierarchy “meta-criteria alternatives” to choose the cloud manager, that can be used for library service of the consumers (Fig. 12).

The each matrix consists of expert assessments of the alternative pairs cloud services that can be used to build a system of information services in the libraries. For example, the computation of the weights of alternatives (CloudFuze, ZeroPC, Mover, Multcloud) by the matrix of pairwise comparisons is observed, built for the criterion “cloud storages integration”. The matrix of pairwise comparisons for this criterion is presented in Table.

Table. The matrix of alternatives pairwise comparisons by the criterion of “cloud storages integration”

cloud managers	CloudFuze	ZeroPC	Mover	Multcloud
CloudFuze	1.00	0.33	5.00	3.00
ZeroPC	3.00	1.00	7.00	3.00
Mover	0.20	0.14	1.00	0.33
Multcloud	0.33	0.33	3.00	1.00

The computed parameters for the matrix of pairwise comparisons acquired such values:  $I_{max} = 6,485$ ;

$CI = 0,0972$ ;  $CR = 0,0784$ . As  $CR = 0,0784 < 0,1$ , the matrix of pairwise comparisons is consistent, then the cloud manager ZeroPC can be determined by the criterion “cloud storages integration” as one that generates the largest value of weight 0.4206. The similar calculations are performed for each criterion.

### CONCLUSIONS

The calculation results confirmed the results obtained by benchmarking methods. The research confirmed the effectiveness of benchmarking methods for defining the best information service. The leader in both experiments is cloud service ZeroPC, which inherent properties for storing and management of a large amount of information resources. This service can be used as a convenient tool of the library information service system.

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