

ANALYSIS OF CLOUD STORAGE SERVICES TO SYNCHRONIZE DATA WITH MOBILE DEVICES USED IN ENTERPRISE

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In the paper analysis of available, free Cloud Storage services for company/enterprise applications is presented. The choice of the most appropriate cloud service will be associated with such features as its compatibility in relation to the terms of use, data security, performance and stability. Performed analysis focuses on solutions which the license does not prohibit the use of their free version of the service for commercial purposes, in the company. An important factor, partly influencing for the choice, will also be intuitiveness, additional functionality and ease of use offered by client applications.

Keywords: Cloud storage, Cloud services, Private cloud, Public Cloud, OwnCloud, Cloud security, Cloud services for Enterprise

1. Introduction

Nowadays, a modern model of data storage in companies and institutions increasingly become cloud storage services [1,2]. This type of services is characterized by buying disk space area from hosting companies for the purposes specified by the customer. In this way, the person/company does not have to worry about the entire data infrastructure, required hardware, but only indicates to the service provider requirements for the needed performance and disk space. Therefore, the responsibility for safekeeping and maintenance of data falls on the supplier.

Besides the above functionality cloud storage services can also be used for easy and optimal data sharing between employees in the company, along with

granting the appropriate access levels. This kind of solution, with possible access from both desktops and mobile devices, doesn't only allow for remote work among employees, but also allow them to work together on documents.

In the paper the analysis of available, free Cloud Storage services with the possibility of using them commercially by companies or enterprises is presented. Nowadays, more and more companies plan to "create" its own private cloud, than use one of public clouds [1,3]. To select the most appropriate service there will be taken into account such features as its compatibility for the intended use, data security, performance and stability. Performed analysis focuses on solutions which the license does not prohibit the use of their free version of the service for commercial purposes, in the company. An important factor, which partly influences for the choice, will also be intuitiveness, additional functionality and ease of use offered by client applications to access by the web browser.

2. What is Cloud Storage?

The concept of cloud storage assumes the use of cloud computing to share IT resources via the Internet. Provider of such a service delivers required resources for the customer, so the customer does not have to bear the investment costs in advance. Additionally the customer does not have to worry about costly and complex infrastructure and the necessary staff to support it. Cloud computing services can be used to run virtual operating systems, data storage (data backup), as well as complex and demanding computational techniques.

2.1. Types of Cloud Storage Services

The concept of cloud storage model (Fig. 1) assumes services that enable the storage, management and remote access to user data over a network (typically by the Internet). We can distinguish three types of cloud storage services [4] (Tab. 1):

- **private cloud storage** is a system designed with access for only one person or organization according to the indicated requirements. This type of cloud storage services can occur in two variants: running locally by the administrator of the corporate network or by outside hosting. Both solutions are good, but from a business perspective, the solution running locally is better/secure, because you have full control over stored data [1, 4]. Administrator of the service that is running in the company can control and design system in terms of what the company/organization expects. Mostly private cloud solution is not available outside of the company's internal network.
- **public cloud storage** allows for management of data to a lesser extent than private cloud and allows access to data through the Internet network [1, 4].

Access to data is restricted to authorized users or those users who have a special address (usually web link). Examples of public cloud services are popular sites such as Dropbox or Google Drive.

- **hybrid cloud** is a combination of a private and public cloud storage. It allows to customize the functions and capabilities of the current demand and gives full control of the stored data administration. The most important data can be protected in a specially designated private space, while less important data can be stored in the public cloud and accessed by multiple users at a distance through the network [1, 4].

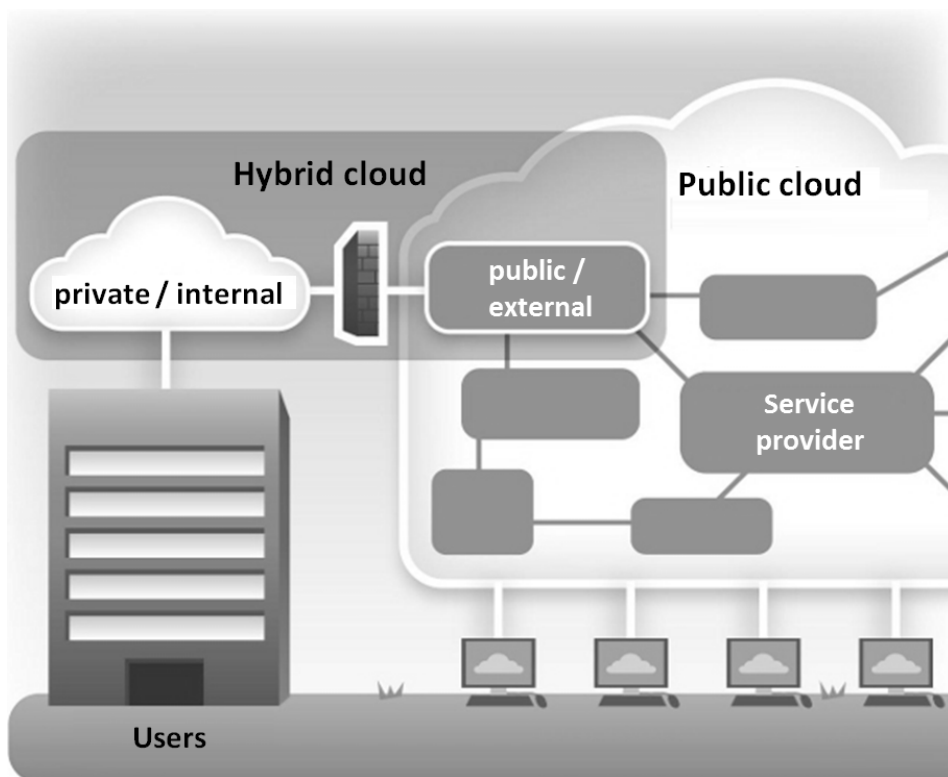


Figure 1. Diagram of the types of Cloud Storage services

2.2. Application of cloud storage services

Cloud storage service can be used for storing important (for the recipient) data. Thanks to this application in the case of sudden failure of customer hardware, there is no fear of losing valuable information [2]. The ability to store data on external servers also allows to quickly share files and documents with your col-

leagues or even work on them simultaneously. Cloud storage services mostly have their own client software to data synchronization so user do not have to worry about sending data to the cloud [1]. Such a solution allows data to be up to date both locally and on an external server.

The main advantage of cloud storage services is the ability of effective and simultaneous work on user or group of users documents. This work can be carried out at the same time from different devices, eg. notebook, tablet, smartphone, without need of manual copy files between two devices. Access to the data is possible from anywhere in the world, you need only access to the Internet, which in the era of mobile broadband (3G / 4G) is not a major problem [3].

Table 1. Comparison of the types of cloud storage services

| Characteristic | Public cloud | Private cloud | Hybrid cloud |
|-----------------------|--|---|--|
| scalability | high | limited | high |
| security | good, depending on the security offered by the service provider | well protected, all data available only within the network | very high, integrated options allow to turn on additional layers of security |
| performance | average | very good | good, depends on the performance of the server on which the service was launched |
| reliability | average, depending on Internet connection and the availability of the service on the service provider side | high, limited to the performance of the internal network | average, depends on the possibility of use of cache memory for frequently used data and the availability of an Internet connection |
| cost | low, because user usually pay only for extra space for data or increase of data transfer | average, because it requires additional expenses related to hardware and costs of electricity | average, because it allows to transfer part of data to an external hosting |

2.3. For whom are cloud storage services designed?

Thanks to the versatile features of cloud storage, it can be used by both the home user as well as large corporations. For the typical user the use of cloud storage often ends up on using the service to store backups that are important from the data point of view, eg. holiday photos or documents. The available services often easily allow to define appropriate access to selected data for other users. About this access decides the owner of the data [1, 5].

The use of cloud storage services is not necessarily limited to storing copies of important data. Services administrator in corporation can define a number of features for user accounts, such as available space (quota), access to a common pool of data, the ability to simultaneous work on documents/files.

3. Data security

One of the most important factors of entrusting our data to the service provider is security of this data. The customer should be assured that the data he sent are secure and there is no possibility of access to them by unauthorized persons. Therefore, when choosing the right service provider for yourself, the most important thing is to check if he is unable to access the data entrusted to him [7]. Sending a strategically important data or reports by the company, and access to them by unauthorized persons may have serious consequences for the institution.

3.1. Methods of data transmission protection

There are two possibilities for secure data transfer [6]. The first possibility is to trust methods of data encryption used by the service provider. Then the obligation of completeness and correctness of the data security is on the service provider side. Most of commercially available encryption services uses standards such as AES, RSA or protocols like SSL. These security features allow to encrypt data in the way that they are unreadable to potential people who have obtained access to them.

Another way to protect data files during transmission is to encrypt them on the client side before sending to the cloud. In this way, the client can be sure that his data will not be read by unauthorized persons. Data can be read only with special key, defined by the user. For example, user can use to do it TrueCrypt container. The disadvantage of this solution is the need to synchronize the entire data container which size can reach several GB. An alternative way is to use special software to encrypt individual files during synchronization and decrypt in situation when the user wants to use them. An example of such software is Sophos SafeGuard. Unfortunately, the use of that application is associated with the purchase of software licenses.

3.2. Data storage on the service provider servers and its security

When choosing the proper cloud storage services, user should be sure that his data are not analyzed in any way, or indexed by the service provider. The collected information on the stored files and their contents could be used to leakage of strategic data and be used by unauthorized persons. Therefore, important factor when choosing appropriate services for customers is to obtain information about that if the supplier is able to get access to our data or/and if the files are stored in encrypted form inaccessible to anyone other than their owner. It is known that different priority have videos stored in the service by an ordinary user who is using cloud storage as an additional storage for backup, and other strategic financial data, and development plans of the company. The second type of data leakage can cause a lot of damage to the enterprise, and even lead to its downfall [7].

4. Analysis of cloud storage services for company applications

The following analysis was commissioned thesis by the Ericpol company based on scientific cooperation with the University of Lodz. Ericpol is a Polish company operating in the IT industry. Headquarter of the company is located in Lodz but it also has offices in Krakow, Warsaw, Gniezno and abroad - in Sweden (Linköping), Ukraine (Lviv) and Belarus (Brest). Ericpol in Łódź employs more than 2,000 people. The company provides services in the areas of:

- telecommunications - services for the design, maintenance and testing of software for the hardware and software manufacturers from around the world,
- M2M (Machine to Machine) - engineering services, mainly in the design and testing of "embedded systems" software class for the largest manufacturers of automotive, eg. Peugeot and Citroen,
- medical market - including specialist programming package "Dr. Eric" for managing beauty salons and medical clinics,
- ERP sector applications and Business Intelligence - solutions for effective business management, used in industry, trade and production management,
- banking and finance - solutions to support Enterprise Management, sales support and debt collection,

The analysis will be used by Ericpol to start the cloud storage service in the internal environment of the company, among employees. Ericpol needs a solution to synchronizing and sharing data/documents between employees. The company depends primarily on the security of stored data, the stability of the service, and easy access to files using both desktops and mobile devices. Mobile devices are mainly controlled by Android and iOS systems. Because the company is working on customer data, these data can not be stored in the public cloud - it determines the poli-

cy of the company. From the Ericpol point of view the best solution is to create its own private cloud and have control over it. For some data in the cloud access can be only from inside the company (from internal network), and to the less critical data access may be remote. User authentication has to be based on two solutions: Radius and LDAP.

At the beginning the private cloud would be implemented only at the headquarter in Lodz. If the solution will work properly, it would be also implemented in other company locations. Some generally defined requirements let to apply different solutions depending on the location/country like eg. type of service server (Linux/Windows) or client software for workstations (Windows, Linux, MacOS).

4.1. Detailed requirements for service

The selected service should fulfill the following features:

- to store data in the company,
- multi-platform services server,
- multi-platform client software for workstations under Windows, Linux, MacOS,
- multi-platform client software for mobile devices controlled by Android, iOS, Windows Phone,
- granularity of security,
- the ability to enforce quotas for users,
- encryption of transmitted data,
- ability to remotely clean content of user account by the administrator,
- document sharing for certain groups of people,
- the ability of simultaneous work on a document,
- friendly client application for user,
- two-component authentication,
- authentication using a RADIUS, LDAP,
- application integration with other programs on mobile devices (web browsers, file managers),
- stability,
- way of data synchronization - sending only the changed files.

4.2. Overview of available cloud storage services

In choosing the most appropriate service, in accordance to the requirements provided by the company, following cloud storage services are analyzed:

- BitTorrent Sync (version 2.3.1) [8],
- Box (version 4.0) [9],
- Copy (version 1.4) [10],

- DropBox (version 3) [11],
- ElephantDrive (version 2.9) [12],
- Google Drive (version – beginning of 2016)[13],
- Mediafire (version 1.8.12) [14],
- MEGA (version 2.8) [15],
- OpenDrive (version 1.4) [16],
- OwnCloud (version 8.2) [17],
- OwnDrive (version 7.0) [18],
- SkyDrive/OneDrive (version 17.3) [19],
- SpiderOak (version 6.1)[20],
- Storino (version 0.9) [21],
- Wuala (version – Wuala Nadelhorn) [22].

The feature of all these services is that their license does not limit the use of the free version for commercial purposes. This eliminates the need of buying a license, if the available options are sufficient for the service user.

4.3. The choice of cloud storage service

After the comparative analysis of available, free cloud storage services, the best solution for company purposes would be an ownCloud service [5] (Fig. 2). The choice of the specified service supports a high level of security of the stored data, the same as most of competing solutions. Data can be encrypted both during storage on server disk and during transmission over the Internet. A strong argument is the fact that, unlike to other free solutions available on the market, selected service allows users to store data within the organization (OnPremise). In this way, control and physical protection of the data lies on the service administrators within the company [23].

The distinguishing feature of ownCloud from the rest services is corporate functionality in the free version. Support for LDAP solutions and integration with Active Directory makes it easier to control user accounts of cloud storage service. OwnCloud easily allows administrator to manage user data, granting privileges for users and groups of users. In addition, it also allows to use the built-in virus scanner to automatically protect the stored data against to computer viruses.

OwnCloud with support for most popular operating systems allows for seamlessly use of this service. Thanks to the open architecture and a shared API, there is a large number of applications for account managing except the official, provided by the authors. The openness of the code gives the possibility of adding custom functionality (if necessary). The advantage of the chosen solution is also its dynamic development and community support creating additional functionality [17].

| Supplier | BitTorrent Sync | Box | Copy | DropBox | Elephant Drive | Google Drive | Mediafire | MEGA | OpenDrive | OwnCloud | OwnDrive | SkyDrive/OneDrive | SpiderOak | Storino | Wuala | |
|--|-----------------|--------------|--------------------------------------|--|----------------|--------------|-----------|------------------------|----------------------|----------|----------|-------------------|------------------------|-------------------|------------------------|----------------------|
| Supported stationary platforms | Windows | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| | Linux | YES | NO | YES | YES | NO | NO | NO | NO | YES | YES | NO | YES | YES | YES | YES |
| Supported mobile platforms | Android | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| | iOS | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Windows Phone | YES | YES | YES | YES | NO | NO | NO | NO | NO | YES | YES | YES | NO | NO | NO | NO |
| Available disk space | | 10 GB | 15 GB | 2 GB | 2 GB | 15 GB | 10 GB | 50 GB | 5 GB | | 1 GB | 15 GB | 2 GB | 4 GB | 5GB | |
| Data encryption | Supplier site | SSL, AES-256 | SSL, AES-256 | SSL, AES-256 | SSL, AES-256 | SSL | | SSL, AES-256, RSA-2048 | AES-256 | AES-256 | | SSL | SSL, AES-256, RSA-3072 | AES-256, RSA-3072 | SSL, AES-256, RSA-3072 | |
| | Client site | | | | | | | | | | | | | | | |
| Folder synchronization | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Public catalog | NO | | YES | YES | YES | YES | | YES | | | | YES | | | | YES |
| External drives support | YES | | | NO | YES | | NO | NO | | YES | | | YES | | | YES |
| The possibility of free additional disk space enlargement | | | YES (5GB for every invited new user) | YES (500MB for every invited new user) | | | | | | | | | YES (max 10GB) | YES (max 6GB) | YES (free coupons) | |
| Two-step verification | | YES | | YES | | YES | | NO | | | | | | NO | NO | NO |
| LDAP support | | | | | | | | | Mapped network drive | YES | | | | | | Mapped network drive |
| Other | | | Low data transfer | | | | | | | | | | | | | |
| The possibility of using the free version for commercial use | YES | | YES | YES | YES | YES | YES | YES | YES | YES | YES | NO | YES | | | YES |

Figure 2. Comparison of services

Service administrator can easily configure ownCloud with a user friendly web interface (Fig. 3). It allows to quickly create user accounts, assign them to the appropriate groups and giving them the limit of disk space for data (quota). Because the service works on a private machine, the amount of space available to use depends entirely on the capacity of the hard drive installed in the computer, on which ownCloud is launched.

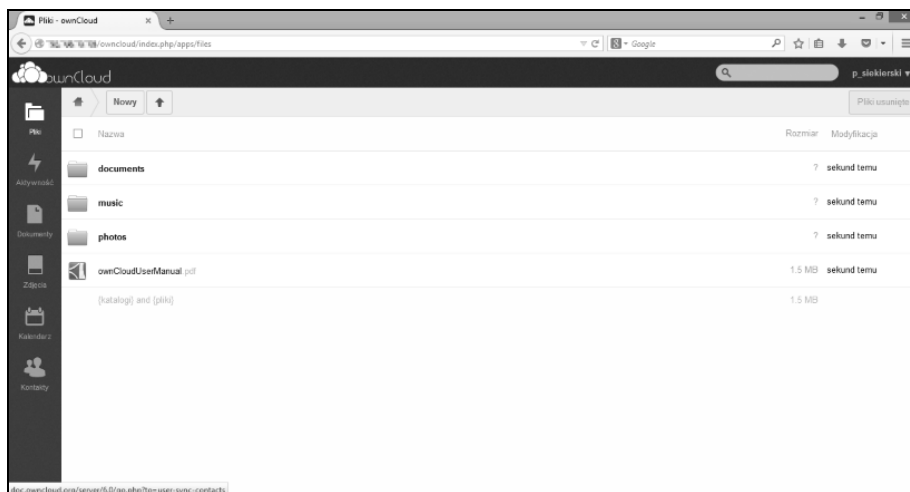


Figure 3. Web Interface of ownCloud service

OwnCloud provides very good data security with versioning of files and encryption of whole directory of each user. All stored data are encrypted using AES-256. As a result, none of the administrators do not have access to the files of people using the service. The file versioning also allows to control changes in files, with the possibility of returning to a previous version of a file. Intuitive configuration interface allows to quickly and efficiently configure the service to work.

In addition to the mentioned above free service capabilities ownCloud developer gives the opportunity to move to a paid Enterprise version, which offers additional functionality and official support for the entire solution [17].

5. Conclusion

In the paper the analysis of available, free Cloud Storage services is presented. The analysis is based on the requirements received from the one of big companies from Lodz - Ericpol. It allowed to get to know possible solutions and to indicate the most appropriate one, with the possibility of its use in the company. The selected service, ownCloud, characterized in that this solution is completely free and can

be used commercially in the company. The results of the analysis were delivered to Ericpol and can also be used by other enterprises that want to deploy this type of a similar service.

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