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uDOC

Your Documents, Anytime, Anywhere

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This document is part of Flavio Yuaca's work plan, during his time as a fellow at the United Nations University Operating Unit on Policy-Driven Electronic Governance (UNU-EGOV) in Guimaraes, Portugal. The work has been accompanied by João Álvaro Carvalho.

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List of Acronyms

AI	Artificial Intelligence
CA	Certificate Authority
GDPR	General Data Protection Regulation
GIS	Geographic Information System
ICT	Information and Communication Technologies
MFA	Multiple-Factor Authentication
OCR	Optical Character Recognition
PoC	Proof of Concept
QR	Quick Response (code)
SDG	Sustainable Development Goals
SIM	Subscriber Identification Module
SMS	Short Message Service
UML	Unified Modelling Language
UNU-EGOV	United Nations University Operating Unit on Policy-Driven Electronic Governance
2FA	Two-Factor Authentication

An idea is like a seed: a tremendous potential that can die without producing a single fruit or can grow to a forest that feeds thousands.

For an uDOC overview, read topics 1.2 What is uDOC? and 1.7 Scenarios of uDOC Use.

For a more detailed uDOC overview, read the following items:

- 1.2 What is uDOC?
- 1.3 Relevance and Context
- 1.7 Scenarios of uDOC Use
- The concept of a substrate-dependent document in 1.6 Basic Terminology
- The concept of a substrate-independent document in 1.6 Basic Terminology
- The first paragraph of all items in 2. uDOC Basic Features and 3. uDOC Special Features

1. Introduction

1.1 Objective

The objective of this white paper is to propose the concept of uDOC, describing its main features.

1.2 What is uDOC?

uDOC stands for Ubiquitous Documents.

uDOC is a document management service that allows users to access their documents anytime, anywhere, using a single interface, regardless of the issuer of the document.

uDOC is based on the concept of substrate-independent documents.

1.3 Relevance and Context

We live in a document-based society. Without a document, a person usually cannot prove the ownership of a house or a car, retire, drive, open a bank account, have a computer repaired under warranty, board a plane, enter a country, study in a university, rent a house or apply for a job. Borrowing a book in a library demands documents. Accessing public health services may be easier with documents. Documents permeate our daily lives.

Even minor improvements in document management may have a huge impact on society.

Currently, some documents are already in digital format. These documents are usually organised by the issuer of the document. A person uses the bank website to access the account statement, the laboratory website to access the results of a blood test, the government website to access the income tax records or a utility's website to get the electricity bill. There may be dozens of different interfaces, passwords, and protocols. The issuer may change the document without the consent or even without the person being aware that the document changed. If the issuer no longer exists, it may be impossible to access the documents or to prove their authenticity.

To increase the control of their documents and reduce the dependency of issuers, some persons prefer to download and store their documents in private storage. Once downloaded, it is difficult to prove that the document is authentic.

In this and other scenarios, the person is responsible for retrieval, organisation, storage, recovery, protection, transportation and other document management related tasks. The efforts to manage a growing quantity of documents are relevant and tend to increase, as more documents are becoming digital.

If the person decides to keep the documents at the issuer's repository, it is necessary to know the documents' policy such as for how long the issuer keeps them online or when the documents will be permanently deleted. Ideally, the person should do this to each issuer, besides keeping track of the policy changes.

Some documents exist in paper, plastic, memory card, or smartphone: passports, identification cards, a visa to visit a country, a digital driver's licence, a vehicle's document and sometimes even a child's school report and vaccination booklet. Paper, plastic and all document attached to a physical layer are subject to loss and deterioration. They may be unavailable at the time and place where they are required.

The main objective of this white paper is to propose the concept of a document management service that allows a person to use a single interface to manage all their documents, regardless of the issuer. This service should allow a person to easily access her/his documents, anytime, anywhere. The proposed service is named uDOC.

- uDOC automatically classifies and organises the documents based on metadata attached by the issuer, using the person's rules or after analysing the documents' content. Besides the default organisational model, uDOC allows a person to create her/his models.

- Using uDOC, the documents, once issued, do not depend on the issuer to exist or to be authenticated.

- uDOC allows documents to be transferred from one person to another.

- uDOC may reduce the complexity of the digital documents and help the transition to a digital society.

- uDOC empowers the person. uDOC transfers the control from the document issuer to the person.

Although unlikely even in the medium term due to cultural, technological, commercial, and other challenges, uDOC may evolve to be a government-recognised document management service, supra national, non-commercial, multi-purpose, multi-object, and universally adopted.

In this scenario, no service would be denied due to a forgotten, lost, or damaged document. In a supra-national case, persons would be able to cross borders of participating countries without carrying a physical passport. Theoretically, there would be no need to carry, store and protect any physical document.

1.4 How Is This Text Organized?

This white paper is structured in the following topics:

- Introduction, which contains a brief presentation of the objectives, basic concepts, examples of uDOC uses and the paper main limitations.

- uDOC Basic Features. It is a non-structured list of items and does not systematically cover all basic features. Each item describes one uDOC feature and is presented in the following format: title, basic description, discussion, and examples. Although there was an effort to address mainly the conceptual level, some discussions may include implementation or technology details to improve understanding. This topic contains features that should be feasible in an initial uDOC implementation. When a feature includes complex operations, at least the basic concept should be considered in the initial implementation.

- uDOC Special Features. This topic covers important features to increase uDOC's outcomes and effects but may be unlikely to be considered in an initial implementation. Some features may be unfeasible considering the current legislation or technology. These features may be considered in an eventual discussion of the uDOC evolution path. It is also presented as a non-structured list.

- Final Discussions: expected outcomes, considerations, privacy issues, and suggestions.

1.5 Limitations

While reading this text, consider the following limitations and observations:

- All examples are fictitious. They may be invalid in some countries and contexts. The purpose is to clarify a concept. The examples may highlight some aspects that are non-relevant in a real situation.

- This white paper contains only a basic description of a concept. It is not intended to be detailed enough to proceed to its implementation. It also does not contain a feasibility study.

- This is an initial approach to the uDOC concept. It should be further discussed, refined, and complemented before even considering investing in a prototype.

- The verbal tense used may suggest that at least a prototype of the service has already been implemented. It has not.

- There may be some discussions involving implementation issues. This is not to be considered a suggestion of a specific technology or product. The purpose of mentioning details is to clarify concepts, connecting them to possible solutions. The focus of the white paper is *WHAT uDOC is* and not *HOW to implement uDOC*.

- Some features are central, whilst others are small details. They might appear mixed in the same list.

- The ideas, concepts, and descriptions in this white paper may present medium coupling and medium cohesion. This means the same idea may appear in more than one topic and each topic, although the focus is on only one main subject, may address more than one concept. For a formal specification, it is suggested to decrease the coupling and increase the cohesion of the text.

1.6   Basic Terminology

The following terminology was used in the context of this White Paper. Some concepts presented in this paper may differ from other accepted concepts. The objective is to support a better understanding of uDOC.

- Document[1]: any information a person wants to preserve. The concept of document used in this White Paper is based on the person´s interest and not on whether the document is relevant or accepted by authorities, mandatory to prove a fact or required to request or to receive a service. Examples of potential documents: an electricity bill, a passport, a diploma, or a letter from the person´s father. The same information may be relevant for one person and not for another.

- Document substrate: the physical layer that supports a document. Examples: paper, plastic card, metal plate, smartphone, disk, SIM card, chip, memory card.

- Substrate-dependent document: a document that needs to be associated with a specific substrate to be valid. If the information contained in a substrate-dependent document is transferred to another substrate, the document is no longer valid. Example: a passport. If the user produces a copy of the passport – using a scanner and a printer, for instance – the copy is not a valid document. Even if the same paper is used, the passport is not valid. Measures to avoid duplication of a substrate-dependent document are usually an important factor. Common substrates include different types of paper, plastic, metal, and chip. For instance, some documents can be presented on a smartphone. If the person changes the smartphone, it may be necessary to register or authenticate the new smartphone. In this context, smartphone documents are substrate-dependent. Substrate-dependent documents are usually subject to loss, damage, forgery and may be difficult to

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[1] For a formal discussion of document and the relationship between document, information and data, see chapter 2. Informação e documento in SILVA, Armando Malheiro da. A informação: da compreensão do fenómeno e construção do objecto científico. Porto: Edições Afrontamento, 2006.

recover if the person is not carrying the document when it is needed. uDOC avoids substrate-dependent documents.

- Substrate-independent document: a document that does not need to be associated with a specific substrate to be valid. The document is the information. Sometimes, this kind of document is used as a locator to access or confirm the document that is requested during a procedure. Example: a boarding pass. The person may board a plane using a digital or printed boarding pass. Most companies will even accept a picture of the printed boarding pass as long as the QR code is readable. A boarding pass is a substrate-independent document. Substrate-independent documents usually can be reproduced by the user in case of loss or damage and may be easier to recover when needed. uDOC promotes the use of substrate independent documents.

- Document locator: data that is used to recover or to find a document. The document locator differs from the document unique identifier – primary or secondary identifiers. The document locator is often used for operational reasons. In this paper, the document locator is also a document: information the person wants to preserve. Example: a car rental voucher can be considered a document, but is usually used only as a key to recover the booking. If the booking is not found in the company's database, the person will probably have to pay again before getting the car, no matter how detailed the voucher is. If the voucher – the document locator – shows a different price compared to the car rental system, the car rental system will prevail. The voucher may contain evidence to help further investigations but has no value by itself. It only helps locate another document that has value. In this case, the voucher is a document locator. The same may happen to a hotel voucher, an e-ticket for a flight or the social security number. Document locators may be mandatory to facilitate the operation but could be replaced, at least technically, by other information capable of locating the same record in the system. Examples: if the passenger lost the e-ticket, the airline would probably accept, during the check-in, a driver's license instead. At the boarding gate, if the passenger lost the boarding pass, it is still technically possible to board. For operational reasons, presenting a boarding pass with a QR code, for instance, could be mandatory. However, the airline may also update the passenger's list manually and allow the passenger to board. If the person lost the voucher for the car rental, it is still possible to conclude the operation if the person mentions her/his name. Document locators usually are substrate independent.

- User: in this paper, a user is a citizen, customer, agency, company and any person or organisation that uses the uDOC services.

- Issuer: is the issuer of a document. The issuer creates a document. Usually, issuers are banks, government agencies, utilities etc. Nevertheless, any user can also issue a document.

- Issuer type: the generic name given to the set of all issuers of the same type. Example: Bank, Laboratory, Government, Utility. Certain uDOC operations can be executed for an Issuer Type. Example: Put all documents related to banks in the financial records folder. No matter if the document is from Japan Post Bank, Mitsubishi Bank, an account statement or a credit card statement, uDOC will store it in the financial records folder.

- Issuer instance: a specific instance of issuer type. Example: Japan Post Bank, Pacific Gas and Electric, Volkswagen.

- Document type: the generic name given to a set of all documents of the same type. Example: Account Statement, Electricity Bill, Passport, Driver's License, Notification, Warranty. Certain uDOC operations can be executed for a Document Type. Examples: Send an email when a notification arrives. *Notification* is the Document Type. Archive all warranties one month after the expiration date. *Warranty* is the Document Type.

- Document instance: a specific instance of a document type. Example: the January 2020 Account 2292-3 Statement, the person's Japanese passport, the notification sent by the Internal Revenue Service (IRS) last week, the person's ASUS notebook warranty certificate. In this paper, a document instance is referred to as *document*.

- Object type: the generic name given to the set of all objects of the same type. Example: Vehicle, House, Bank Account. Certain uDOC operations can be executed for an Object Type. Example: Put all documents related to *bank accounts*, no matter the bank, into the Financial Documents Folder.

- Object instance: a specific instance of an object type. Example: Toyota Corolla License ABC 123, Japan Post Bank Checking Account 2292-3. In uDOC, a document belongs or is related to an object instance. Example: the document Monthly Account Statement is related to the Japan Post Bank Checking Account 2292-3.

- Supertype: a set of document types, issuer types or object types. The document, issuer, and document types may have a supertype. Example: the issuer supertype "Health" may contain the issuer types "Hospital", "Laboratory", and "Clinic". Supertypes can be used, for instance, to model a hierarchical system to organise documents. A supertype may contain – or be hierarchically superior – to another supertype. Example: the issuer supertype "Personal Services" may contain the supertypes "Health" and "Education". A type or supertype may appear in more than one supertype. When created, a document is associated with an issuer type, a document type, and an object type. It is not associated with supertypes. uDOC may have one or more supertype structures and users may create their own. Supertype structures can be changed any time, causing uDOC to reorganise and manage all documents accordingly to the new structure. A supertype structure can be updated, deleted, or created without affecting documents. They affect the organisation of the document but no document is changed due to a change in the supertype structure. In this sense, documents are independent of the supertype structures they belong.

1.7   Scenarios of uDOC Use

The following scenarios present hypothetical uses of uDOC. They are not valid, relevant, or applicable in all contexts. They may depend on non-existent legislation or infrastructure. The objective is to facilitate the understanding of uDOC concepts.

- John is verifying the tax income forms. Using uDOC, he finds all documents related to earnings in a single folder. Another folder contains all deductibles. All earnings and

deductibles were provided by many different organisations. John did not ask for the documents. He only informed the uDOC to accept all incoming documents. When he entered uDOC, all documents were already there.

- John's computer broke. John bought the computer months ago and never saw the documents. The retailer sent them directly to John's uDOC. Using uDOC, he found a single place with all documents related to that equipment, including the warranty certificate and the receipt.

- A 2019 Supreme Court decision determined that all 1995 savings account holders are entitled to receive compensation. John has to prove he had a savings account and its balance in 1995. In a scenario with uDOC being used in 1995, John was able to find all account statements in a single folder, organised by account number and year. Although the bank went out of business in 1999, uDOC certifies that the statements are authentic and were issued by the bank. John forgot that the bank was sending those statements until the day he needed them.

- John and his family are on a 20-day vacation visiting European countries. They booked hotels in different cities, rented cars, bought airplane, train and museum tickets, and booked restaurants. uDOC created a folder with all documents related to the trip. uDOC even organised the documents by date and time. John could check all documents related to activities on each day of the trip: airline tickets, hotel vouchers, museum tickets, etc. John did not spend time organising, downloading, or requesting documents. uDOC received and organised all travel documents without even John knowing.

Although unlikely to be implemented in initial phases, the following examples show how uDOC could evolve to be more relevant to users.

- John was renting a car and realised that he forgot his driver's license at home. John presented the driver's license in his uDOC smartphone app and he was able to get the car. Although the Department of Motor Vehicles (DMV) also issues a digital driver's license, John prefers to use uDOC. The DMV app has only digital documents issued by the DMV. uDOC manages all documents, regardless of the issuer.

- John was at the bank and realized that he forgot his ID. John presented the ID in his uDOC app on the smartphone. Due to the bank's security policy, the smartphone's uDOC was not accepted. With John's authorization, the bank teller, using the bank's smartphone, verified John's online ID certified by the Government Authority and authorised a cash withdraw.

- John sold his car. He asked uDOC to transfer all car's documents to the buyer. uDOC listed the documents that would be transferred. John excluded the traffic tickets but allowed uDOC to transfer the original receipt and all maintenance records.

- John is a refugee. During the escape, he lost his suitcase, smartphone, passport, and all documents he was carrying. John arrived in the new country with only the clothes he was using. John used uDOC to recover his passport, university's diploma, medical records, driver's license, and even the glasses prescription and old bank account statements. John went to an authorized uDOC office and asked for a printed and certified version of the

diploma. Even though the new country did not automatically recognise the documents, they proved to be essential for John's new life.

Specific examples can be found in the discussion of uDOC Features.

The remaining of this white paper helps the reader understand what uDOC is and how uDOC can provide these and other services.

2. uDOC Basic Features

2.1 Single Interface

uDOC allows users to use a single interface to access all their documents, regardless of the issuer.

DISCUSSION

Each document issuer may have its interface for document access. The user has to use different interfaces: the bank interface to access the account statement, the car dealer interface to access the parts and maintenance receipt, the airline interface to recover the e-ticket, the utility interface to check this month's electricity bill, the university interface to access the student's report, the laboratory interface to get the blood test results, the government interface to recover government documents.

Different interfaces with different protocols, different user IDs, and different passwords.

Example: to access the bank statement, the user has to enter the bank account, password and the token sent through SMS. If the user cannot receive an SMS at that moment, the access will be denied. To access the electricity utility bill, the user has to supply his social security number and a password. To access the blood test results, the user has to provide a code informed when the blood sample was collected.

Example: the user has to complete the income tax forms, detailing all revenues and expenses. The user has a few bank accounts, made a few operations at the stock exchange and holds bonds. He lives in a rented house and rents his house in his hometown through a real estate administration company. He received salaries from two employers last year and had some medical expenses. The user will have to log in to dozens of websites, recover passwords, discover how to navigate in each of them and maybe make some phone calls and send emails about documents that he did not find.

The need to learn, manage and use these different interfaces may pose a barrier for some users to access their documents. Sometimes they become dependent on someone else for these matters.

uDOC proposes a single interface that allows a user to access all documents in a single place.

Example: the electricity company, the bank, and the telecom utility send every month their bills and statements to the user's uDOC. The user uses a single password and a single interface to access uDOC. At uDOC, the user can query all documents from the electricity company, the bank, and the telecom utility.

uDOC does not propose that the issuer should disable its interface. Nevertheless, in a scenario where uDOC is considered reliable and safe and that all customers are uDOC users, some organisations may consider disabling their customer's documents portals.

2.2 Organising Documents

uDOC automatically organises and classifies the documents.

DISCUSSION

Organising documents may be a time-consuming task. Older documents may be organised differently than new documents. Changes in lifestyle may change the user organisational model.

Example: when the user had only one property – a house – all electricity bills were in a folder, and water bills were in another. After buying an office, the folders remained the same: one for electricity and one for water. Only after buying a house on the beach, the user decided to have one folder for each property. Documents of many years were already on file and were kept as they were. New documents went to the new folders. In this example, the user downloaded the documents in PDF and JPG formats, and the folders were computer folders.

uDOC proposes that the documents should be organised for the user. Currently, without uDOC, online documents are typically organised from the issuer point of view, at the issuer´s portals, under the issuer´s policy.

uDOC automatically organises the documents.

uDOC has a default organisational model. All documents are organised at least using the uDOC model. If the user authorises someone to access his documents, the person may be familiar at least with the uDOC default model. The default model organises documents at least by:

- Object Type, Object, Document Type, and Date of Issue. Groups all documents of an object.

- Object Type, Object, Date of Issue. Shows the history of an object.

- Date of Issue, Object. Shows the history of the user.

- Document Type, Object Type, Object, and Date of Issue: for instance, all warranty certificates are gathered in one folder and all receipts in another, no matter the object.

uDOC allows its users to create a custom organisational model.

uDOC uses metadata provided by the issuer to organise the documents. Object Type and Document Type are examples of metadata provided by the issuer.

uDOC uses AI to generate metadata by analysing the document's content. For instance, if the user has hotels, cars and flight reservations for three different trips, uDOC can group documents for each trip after analysing destinations, dates and other parameters.

uDOC allows the same document to appear in different document folders. For instance, a car's receipt may appear in the car's folder, in the warranty certificates folder, and in the IRS folder depending on the active organisational models.

uDOC reorganises all documents every time the user changes or creates an organisational model. Some reorganisation may take a longer time to be executed, depending on the number of

documents, complexity of the rules, and if the rules involve OCR (Optical Character Recognition) and AI (Artificial Intelligence).

uDOC allows the user to organise the documents manually using idiosyncratic conditions.

2.3   User's Rules

uDOC allows its users to manage their documents, using their own rules, regardless of the issuer.

DISCUSSION

In most cases, the user's documents are organised from the issuer's point of view, under the issuer's rules. For instance, the issuer may determine:

- for how long a document will be available;

- the interface and protocol for the user to access the document;

- if the document can be authenticated by a third party ;

- the folder or web pages structure used to store different types of documents;

- the filename of the document when downloaded.

Example: a user has three accounts in a certain bank. The statements are kept online for up to six months. After that, they are kept offline for up to five years, but the user has to pay a fee and wait a few days to access the statements. The user would prefer to have all statements for the same month in the same place, but the bank defined that the user has first to access each account and then the statements. When the user downloads the statements to avoid depending on the bank, the filename is set to *mmm-dd-yy-Monthly Report.pdf*. The user would instead prefer to have the filename set to *yyyy-mm-dd-bank-account.pdf*. This was not a problem for a few documents from a few issuers. However, with dozens of issuers and hundreds of documents, the user realised that there was a considerable amount of effort to keep everything organised.

With uDOC, the issuer of the document may still define when a document expires. However, the user decides what to do with an expired document and not the issuer.

With uDOC, users can define their own rules to manage documents: how they should be organised, what kind of security should protect their documents, when a document should be deleted, or archived and even what should be the filename in case of download. No matter the issuer of the document, the user's rules will prevail.

2.4   Documents Seek the User

The user does not spend time looking for documents. When ready, the document arrives at the user's uDOC repository.

DISCUSSION

In some cases, users do not know when their documents will be available. Each issuer has its own rules. Even when the issuer defines a date to publish a document, the user may not find the documents at the expected date because of a delay.

The user may spend time constantly checking if a document was published at the issuer's website:

- Selection process results to work in a company;

- Selection process results for being accepted at a university;

- Laboratory test results;

- Account statements;

- Bank loan approval;

- etc.

uDOC proposes that issuers should send documents to the user's uDOC repository instead of the user going after the documents.

With uDOC, the user does not need to periodically check if a document was published at the issuer's website.

When ready, the document will be posted at the user's uDOC repository.

uDOC will send a notification through the channels specified by the user.

See 2.19 Automatic Actions.

Many issuers notify the users when a document is ready. A laboratory, for instance, may send an SMS when the blood test result is ready for download. However, another laboratory may have a different policy. Each issuer may use a different channel.

uDOC standardizes the notification process from the user's point of view and not from the issuer's point of view.

With uDOC, notifications for a specific user are standardised for all issuers instead of notifications for all users are standardized for a specific issuer.

With uDOC, it is not the user that goes after a document, but it is the document that goes after the user.

With uDOC, documents automatically arrive in a single place and are automatically organised.

2.5   Document Immutability

With uDOC, the issuer cannot change the document.

DISCUSSION

Without uDOC, in some cases, the issuer may change an existing or published document without the user's consent or even without the user being aware that the document changed. The document is in the issuer's database and can be replaced or deleted whenever the issuer wants.

The user may find it hard to check all documents trying to detect changes. Even if the user notices a change, it may be difficult – or even impossible - to prove that the issuer changed the document. The reliability of the document depends on the reliability of the issuer and the issuer's rules. The same document may have different content if read at different times.

Example: there was an error at the processing of the account statement, and the statement balance was higher than the real balance. The customer decided to make a purchase based on the statement balance. The bank discovered the error and, considering that the statement was published only for a few hours, decided to correct the balance without any warnings. The customer was surprised when his account balance got negative. He was sure that there was more money but after checking his account statement on the bank's website, concluded that he probably miscalculated something. Even if he had a hardcopy or the pdf of the account balance, he would depend on the bank assuming the error to prove that he was right.

With uDOC, once the document is created and sent to the user, it is technically impossible for the issuer to change, replace, delete, or deny the issuance of the document. The issuer can publish a new version, can alert the user that the document was revoked, and even declare that the validity of the document will be no longer recognised.

See 2.8 Document Issuance.

See 2.9 Document Transfer.

See 2.12 Document Revoke.

2.6   Document Independency

With uDOC, a document does not depend on the issuer to continue to exist and to be authenticated.

DISCUSSION

If an issuer no longer exists, the documents may be inaccessible or may no longer be recognised. The existence of the document may depend on the issuer.

Example: the user is selling his car and wants to prove that he replaced some parts. He tries to access the car maintenance records, but the car dealership went out of business, and the website is no longer available.

Example: every month, the user carefully downloads the account statements. One day, the user was asked to show evidence regarding his cash flow. After presenting his bank statements, he was asked to obtain some proof – it could be a stamp from any bank employee - that those bank statements were issued by the bank. Unfortunately, the bank closed the branch in the city, and there was no one nearby to attest the documents.

uDOC receives the document from the issuer and stores at an uDOC repository. uDOC does not rely on the issuer's database to store the document.

A document does not depend on the issuer to continue to exist. There are special transfers that may affect the existence of a transferred document.

See 2.9 Document Transfer.

uDOC certifies the document's issuer, date of issue, content, and other metadata.

uDOC does not attest that the document reflects reality or is correct.

See 2.11 Document Certification.

2.7   Document Ownership

Every document has at least one owner.

DISCUSSION

The document owner is a user that has special rights on the document.

When a document is issued, the issuer can define the owner.

Example: a bank can define that the customer is the owner of the account statement.

The owner changes when a source user transfers the document with ownership to a destination user.

See 2.9 Document Transfer.

uDOC allows a document to have more than one owner.

uDOC will execute some operations accordingly to the type of ownership:

- The operation will be executed if requested by any owner.

- The operation will be executed if approved by the majority of the owners.

- The operation will be executed if approved by all owners.

- The operation will be executed if not denied by any owner within a predefined interval.

When a document has multiple owners, each owner can execute any operation that does not change the document or its metadata – reading the document, for instance. Operations that change the document or its metadata – transferring or deleting the document for instance – will depend on the type of ownership.

Example: a house belongs to three persons. The house deed – the document – has three owners. The ownership type may state that the house deed can only be transferred or deleted with the authorization of all owners.

Example: a checking account has two holders. All account statements – documents - have also two owners. The owners defined that any of them can transfer or delete an account statement.

A document that has multiple owners is different from a document that has copies with multiple users.

When a document that has multiple owners is deleted, it is deleted for all users. It is a single document owned by many users.

When the document was transferred to many users, each user can delete his copy without affecting the others.

2.8   Document Issuance

Issuing a document is the act of creating a document in uDOC and transferring to its owner.

DISCUSSION

Issuing a document has two parts:

- Creation of an uDOC document.

- Transfer of the document to the owner.

To create a document, the issuer can upload it or use an uDOC web service. The issuer must also provide a minimum set of document metadata. uDOC automatically updates some of the metadata: issuer, issue date, etc.

See 2.26 Document Metadata.

Usually, a document is issued by a bank, utility, school, laboratory, or some government agency, but any uDOC user can issue a document.

Example: any user can issue a curriculum vitae and use uDOC to transfer it to prospective employers.

All documents are initially created at the issuer's uDOC. The issuer cannot create a document in another user's uDOC repository.

When the issuer is not the owner of the document, the issuer transfers the created document to the owner. This is the case of bank account statements, utility bills, diplomas, or a driver's license. The owners of these documents are the titular of the account, the owner of the house that uses the utility services, the student, or the driver.

See 2.9 Document Transfer.

When the issuer is the owner of the document, the document is kept at the issuer's uDOC. This is the case of a personal curriculum vitae, for instance.

Once issued, a document cannot be changed by the issuer, owner, or any other user.

See 2.5 Document Immutability.

2.9   Document Transfer

uDOC allows a user to transfer a document to another user.

DISCUSSION

Example: the property owner asked for a notarized copy of the user's job contract, who is a candidate to rent a house.

With uDOC, the user can transfer a copy of the contract directly to the property owner's uDOC. uDOC will certify who issued the contract and if the copy is equal to the original.

In a transfer operation, the source user sends a source document, and the destination user receives a destination document. Source and destination documents refer to the same document but may have different metadata for the source user and destination user.

uDOC may transfer:

- A document without the ownership. The destination document has the same issuer, date and time that the document was issued and contents as the source document. The source user keeps the source document and all associated rights.

- A document with the ownership. uDOC transfers the source document with all associated rights. The destination user becomes the owner of the destination document. The source user is no longer the owner of the source document. By default, the source document is not deleted and is kept at the source user's uDOC. The source user may opt to transfer the document's history up to the transfer. By default, uDOC does not transfer the document history to the destination user. The destination document will have a new history that begins with the transfer.

- A pointer to the document. This special transfer allows the destination document to be updated when the source document is replaced by a new version. The user that owns the document that the pointer refers to, can change the pointer from one document to another document – a newer version, for instance.

Example: a user wants to send the curriculum vitae to the employment agency. After sending the document, the user updated the curriculum vitae, creating a new document. In this situation:

- If the user transferred a "document without ownership" to the employment agency, the agency will have the old curriculum, no matter if there is a new version.

- If the user transferred a "pointer to the document", the agency will have the old curriculum vitae at first. As soon as the user changes the pointer from the old version of the curriculum to the updated version, the agency will have access to the new version.

As the concept of document pointer may be difficult to understand for some users, uDOC may adopt the concept of the newest version of the document. uDOC may help the user manage document versions by automatically analysing the document's content and identifying versions.

Example: the user renewed the driver's license that was about to expire. The new driver's license was put in uDOC. uDOC, after analysing the old and new driver's license, and knowing that the driver's license was sent to another user using a "pointer to the document" transfer, suggests the pointer to be updated.

When transferring a document, the user may choose if the destination document can be used as a source document in another transfer operation and for how many degrees:

- No degree restrictions: the document can be transferred to other users without restrictions.

- Degree 0: the document cannot be transferred.

- Degree 1: the document can be transferred. The destination document will have Degree 0.

- Degree 2: the document can be transferred. The destination document will have Degree 1.

- Degree n for n>0: the document can be transferred. The destination document will have Degree n-1.

Example: the user wants to send the curriculum vitae to an employment agency and expects that the curriculum will be sent to prospective employers. The user does not object if the curriculum is sent by prospective employers to other companies. In this situation, the user may transfer the curriculum to the employment agency with no degree restrictions.

Example: Company A was preparing a proposal and asked User A to send a curriculum vitae. User A wants to avoid the curriculum to be used in proposals by companies other than Company A. In this situation, User A may transfer the curriculum to Company A, using degree 1. Company A can send the curriculum to the Bidder. Company A may send the curriculum to Company B, C, and D, but these companies will not be able to transfer the curriculum to the Bidder. Company B may create a new document using the curriculum sent by Company A. The new document will have the same content – it is a copy of the curriculum – but will have a different issuer – Company B will be the issuer, instead of User A. If Company B sends the curriculum to the Bidder, uDOC will certify that the curriculum was issued by Company B and that the contents are the same as the document created by Company B and not by User A.

See 2.15 Document Copy.

The source user can define for how long a document should be at the destination user's uDOC: no expiration date, 30 minutes, one day, six months, etc. After the defined time, uDOC will delete automatically and permanently the document from the destination user's uDOC. If the document was transferred to other users, all documents will be deleted. Only the owner's document will remain. This option is only valid for transferring a document without the ownership.

Example: the user wants to buy a computer in instalments. The retailer asked a copy of the payslip from the last three months to be used only for the process of approving the credit. The user transferred the payslips but defined that they should be deleted after one day.

The source user can define if the destination document is deleted or not when the source document is deleted. When the destination document is set to be deleted, uDOC warns the destination user about this condition. This option is only valid for transfer a document without the ownership.

The source user can define what part of the document should be transferred. The source user may restrict the transfer to a subset of the document.

Example: the landowner requested proof of income. The user sent the payslip but restricted the transfer to the net salary, without disclosing the job position and details of earnings and deductions. uDOC certifies to the landowner that the net salary is authentic.

See 2.11 Document Certification.

The source user can define if the transfer may be revoked. If the transfer is revoked, the destination user cannot access the document anymore. If the destination user transferred the document to other users, all transfers are also revoked. By default, no transfers can be revoked, and uDOC acknowledges the destination user when this option is activated. If a document was transferred with the revoke clause activated, the source user can deactivate it. Once deactivated, the source user cannot reactivate it. It is a revoke of the transfer and not of the document.

Example: the source user is selling a car to the destination user and sent the car's documents with the revoke clause activated. If the transaction is done, the source user may deactivate the revoke clause. If the transaction fails, the source user may revoke the transfer. The destination user will no longer have access to the car's documents.

The transfer operation can be done for a single document – a document instance – or for all documents that belong to an object instance.

Example: the source user may transfer the beach house deed to the destination user or may transfer all documents of the beach house, including the deed, all electricity bills, water bills, receipts of maintenance, etc. uDOC shows all documents before the transfer, allowing the source user to include or exclude specific documents.

The user may preauthorize some documents to be transferred to certain groups of users upon their request. The user may define parameters for the preauthorized transfers, such as duration, transfer degree, etc.

Example: the user preauthorized his family doctor to access all laboratory test results. The doctor can retrieve the documents without asking specific permission to the user.

Example: the user preauthorized all doctors to access all laboratory test results. Any doctor can retrieve any laboratory test results without asking specific permission to the user.

uDOC allows preauthorization to members of a list.

See 2.25 uDOC Lists.

Preauthorization should be used carefully and periodically revised.

See 2.24 uDOC Dashboard.

Transferring a document is different from copying a document. A transfer operation does not create a new document. It is the same document that can be accessed by one or more uDOC users.

Copying a document creates a new document. The original and copy are different documents although the content is the same. The issuer and date of issue, for instance, are different.

See 2.15 Document Copy.

See 3.1 Present a Document.

2.10 Document Receipt

A user can request to uDOC a receipt that confirms when a document was transferred to another user.

DISCUSSION

A receipt is usually requested by the issuer of a document, but any user who transferred a document to another user can also request a receipt.

See 2.8 Document Issuance.

See 2.9 Document Transfer.

Sometimes, the source user – the issuer, for instance - has to prove that the document was transferred to the destination user. If the document was published only at the source user's website, it might be harder to prove that the document was delivered. The source user may show evidence – the log, for instance - that the destination user downloaded, opened or at least received reasonable warnings that the document was available, but cannot prove that the document was delivered.

uDOC, as a third party, can confirm that the document was transferred to the destination user.

To request a receipt, the source user must send the transfer date, time and the original document. uDOC confirms if the source user transferred a document with such characteristics. The requirement to present the original document minimizes privacy issues. The issuer must possess the contents of the document to request the confirmation. It is not possible to request a receipt for generic documents.

Example: the bank cannot ask uDOC to provide a list of all account statements it transferred to a customer. The bank can ask uDOC to provide a receipt for a specific account statement if the bank has the details of that specific delivery, including the contents of the account statement.

The source user can request the receipt anytime, even decades after the document has been transferred.

The receipt can attest one of the following situations:

- The document was not sent by the source user.

- The document was received by the destination user.

- The document was refused by the destination user but is in the quarantine vault. This means the document can still be received by the destination user. The destination user did not read the document but may decide to receive and read it.

- The document was refused by the destination user and is not at the quarantine vault. This means the document cannot be received by the destination user. The destination user did not read and cannot decide to read the document in the future.

The receipt can attest that the destination user did NOT read the document. However, the receipt cannot attest that the destination user read the document.

The receipt does not inform if the destination user opened, archived, or deleted the document. The source user may infer that the destination user accepted an originally refused document by comparing two receipts.

uDOC can produce a receipt even for documents that were archived or permanently deleted. uDOC cannot access the content of a permanently deleted document. By keeping the hash code of the document, uDOC can issue a receipt without knowing the document's content.

2.11 Document Certifications

uDOC certifies some characteristics of the document.

DISCUSSION

uDOC can issue different certificates for a document.

- Certificate 1: confirms who the issuer of the document is.

- Certificate 2: confirms that the contents did not change since the document was issued.

- Certificate 3: confirms the date and time when the document was issued.

- Certificate 4: confirms who the owner of the document was at the moment the certificate was issued.

- Certificate 5: confirms certifications issued by other uDOC users.

- Certificate 6: confirms transfer information: source and destination users, date and time of the transfer.

- Certificate 7: confirms the current validity of the document. See 2.12 Document Revoke.

- Certificate 8: confirms the validity of the document at the moment of transfer.

Certificates 1, 2, 3, 5, 6, and 8 are always available, to any document and to any user that has access to the document, even if the user is not the owner of the document.

Only the owner of a document can issue a Certificate 4 or 7.

If the source user transferred a document to the destination user, certificates 1, 2, 3, and 5 would be the same, regardless if the certificates are issued for the source document or the destination document. Most of the metadata for both the source and destination documents are the same.

uDOC uses a hash code for the certification process and a public database for auditability purposes. The public database may be implemented using blockchain concepts.

uDOC uses a structure similar to a website security certificate and also relies on a trusted Certificate Authority (CA) to verify the identity of issuers. uDOC has its own CA.

2.12 Document Revoke

uDOC allows the issuer to revoke a document.

DISCUSSION

The issuer of a document can revoke it. Revoke means that the issuer no longer recognizes the document as valid. A revoked document is not deleted. Revoking only marks the document as revoked. The user can still perform all operations on the document, including present and transfer.

uDOC will warn the destination user that the document was revoked.

The document owner can still issue all certificates: issuer, date, contents, etc. The validity certificate will show when the document was issued and when it was revoked.

The issuer can annotate an observation – or reason – for the revoke. The timestamp of the revoke is generated by uDOC and not by the issuer.

Example: the bank sent an account statement to the user. After a few hours, the bank discovered an error in the balance, revoked the original statement and issued a new one. If the user sends that account statement as a proof of financial records, it will warn the destination user that the bank no longer recognizes that statement as valid. The user can still prove that the statement was issued by the bank, at a certain date and that the document is authentic.

Example: the Department of Motor Vehicle (DMV) issued a driver's license. Due to violations – driving under the influence of alcohol for instance – the DMV revoked the driver's license and annotated the reason. The driver can still present the document to prove the date of birth, for instance, but the destination user will know that the document was revoked by the DMV due to law violations.

The issuer can create a document with a No Revoke clause. This means that even the issuer cannot revoke the document. The issuer can define when the No Revoke clause will be activated.

Example: the university issued a diploma with a No Revoke clause to be activated three months after the creation of the document. The university can revoke the diploma only during these three months.

A document transferred without ownership is not revoked when the original document is revoked. It keeps the validity of the moment of the transfer.

See 2.11 Document Certification.

2.13 Document Annotations

uDOC allows the issuer to annotate a document.

DISCUSSION

The issuer of a document can send an annotation to a document. Only the document owner can see the annotation.

Example: after sending the bill, the water company discovered that it charged less than the actual consumption. It sent an annotation to the bill informing that the difference would be charged in the next bill.

The user can refuse to receive annotations from certain issuers or for a specific document.

The user can opt to be informed when a document receives an annotation.

See 2.19 Automatic Actions.

Users can annotate any document that is in their uDOC repository.

uDOC may recognize different types of annotation:

- text
- URL
- phone number
- email
- etc.

2.14 Document Attachments

uDOC allows the user to attach files to a document.

DISCUSSION

Any digital file can be attached to a document.

2.15 Document Copy

uDOC allows a document to be copied.

DISCUSSION

Any document that can be visualized can be copied.

A copy operation creates a new document. The issuer of the new document is the user who executed the copy.

New metadata is created. Although the content is the same, the original and the copy are not considered the same document. They have different issuers and different certificates, for instance.

A transfer operation – transfer without the ownership - does not create a new document.

See 2.9 Document Transfer.

2.16 Document Search

uDOC locates documents that satisfy the search criteria specified by the user.

DISCUSSION

uDOC may find documents by issuer, date, type, content, and other search criteria defined by the user. uDOC allows a list of documents to be refined or combined.

Example: the user searches all documents issued by Banks. uDOC returns 7.539 documents.

The user searches all documents that are contracts and specifies that this search will be applied only on the 7.539 documents previously selected. uDOC returns 74 documents.

The user searches all documents that are from the last three months and specifies that this search will be applied only on the 72 documents previously selected. uDOC returns three documents.

These three documents are issued by banks, are contracts, and were issued in the last three months.

The user may also use uDOC to locate similar documents. The user may choose the degree of similarity.

Example: with a low degree of similarity, if the user presents a computer's warranty certificate, uDOC will locate all documents related to computers and all warranty certificates.

Example: with a high degree of similarity, if the user presents a passport, uDOC will locate all valid and expired passports of the same person.

Example: with a very high degree of similarity, if the user presents a driver's license, uDOC will locate only the same driver's license. The driver's licenses must have the same content, even if they are in different formats.

2.17 Document Archive, Convert, Delete, Export, Print, Share

uDOC has a toolbox to manage documents.

DISCUSSION

uDOC allows users to execute common operations on their documents:

- Archive a document. Archive means that the document will no longer appear in a search or folder unless the user specifies that the search should include archived documents. It is the same as delete, except that the document is never permanently deleted. The document can be de-archived.

- Convert a document. Convert the format of the document. For instance, a document in PDF format may be converted to JPG format. Not all formats can be converted. For instance, a JPG format with images may not be converted to a TXT format. The converted and original documents have the same issuer and certificates.

- Delete a document. Delete means the document will be sent to the trash. The trash will be emptied accordingly to the rules: manually or after reaching a specified number of days, documents or size, when the older documents will be permanently deleted.

- Export a document. Users may choose the format and which metadata will be included. uDOC will prepare the documents to be downloaded or to be sent to cloud storage. When uploading exported documents, uDOC will create new documents, regardless of the metadata and the export format. To transfer documents between accounts, see 3.11 Service Providers. The user can specify rules for filenames for exported documents.

- Print a document. Users may choose which metadata will be included and can specify rules for filenames.

- Share a document. Users may choose which metadata should be included. Share means a copy of the document can be sent to other users using email, WhatsApp, Skype or any other available communications channel. Share does not transfer the document. It sends a PDF or image version of the document.

All operations can be performed for a single document or a list of documents. The user can specify which documents will be part of the list.

2.18 Document Expiration Date

uDOC controls document expiration dates.

DISCUSSION

Some documents have validity. At or before the end of the validity, the user may want to take some action.

Example: the driver's license will expire in five years. The user wants to be notified three months before.

Example: the user invested in 2-year bonds. Two weeks before the maturity, the user wants to study options of investments.

Example: the user bought a car with a 1-year warranty. The user wants to be informed with sufficient time to upgrade his car insurance to cover mechanical failures.

The user may decide if uDOC should issue a warning when a document is about to expire.

uDOC allows the issuer to set an expiration date. For instance, a supermarket issued a receipt for food and set the expiration date for one week. The same supermarket issued a receipt for food and a piece of electronic equipment that has a 1-year warranty and set the expiration date for 12 months.

See 2.19 Automatic Actions.

2.19 Automatic Actions

With uDOC, the user may automate some operations based on rules and conditions.

DISCUSSION

uDOC allows the user to perform the following actions:

- Delete a document.

- Archive a document.

- Transfer a document.

- Sends a message to a user.

- Etc.

uDOC identifies the following conditions to activate actions:

- Expiration date

- Specific date defined by the user

- At the beginning of a new fiscal year

- At the end of a fiscal year

- At the first day of the year

- At the last day of the year

- Warn request sent by the document issuer

- Upon document arrival

- Upon annotation on a document

- Etc.

For triggering purposes, the user can define the delay - add or subtract days - for all conditions related to dates:

- immediately

- *n* days before the expiry date

- *n* days after the beginning of the fiscal year

- the last working day before the expiry date

- etc.

uDOC allows the user to configure actions for:

- All documents

- Object Type: car, house

- Object Instance: a specific car

- Document Type: electricity bill, driver's license, notification

- Document Instance: a specific certificate of warranty

- Issuer Type: the government, a private company, an airline

- Issuer Instance: a specific government agency

- Combinations

- Issuer Type and Document Type: supermarket receipts,

- Issuer Instance and Document Type: IRS notifications

- etc.

Example: The user wants to be immediately notified by email and SMS if the IRS sends a notification. In this example:

- Action: warn

- Condition: upon document arrival

- Delay: immediately

- Action for: document type equal to notification and issuer instance equal to IRS

- Channel: email and SMS

Example: The user wants to be notified when any laboratory test results arrive.

Example: The user wants to be notified 3 months before his driver's license expires.

The user can choose if the warning will appear in the uDOC warnings, be sent by email, SMS or any other available communications channel.

The user can configure the blackout warning period. For instance, the user may choose to do not receive warnings during weekends or between 1700 and 0900. The user can configure if a warning that is due during the blackout will be sent just before or after the blackout.

2.20 Right to Refuse a Document, Annotation or Request

uDOC allows the user to block documents, annotations, and requests from undesired or unknown issuers.

DISCUSSION

The user may choose if uDOC should:

- Block only the specified documents.

- Accept only the specified documents.

The user may authorise or block documents by:

- Issuer Type or Instance

- Object Type or Instance

- Document Type

- Combination of criteria

- uDOC Lists. See 2.25 uDOC Lists.

Example: the user may allow all

- Documents from banks (issuer type)

- Documents from Bank A (issuer instance)

- Documents for Account A (object instance)

- Notifications (document type)

- Notifications from the government (document type and issuer type)

- Receipts for Vehicle A (document type and object instance)

uDOC also has a quarantine vault that receives all refused documents. The user may manually accept or permanently refuse documents in the quarantine vault. The user may define how long a document should remain in the quarantine vault:

- Until it reaches a specific size;

- Until it reaches a specific number of documents;

- Immediately deleted;

- 30 days;

- Etc.

uDOC allows only the following operations on refused documents:

- Accept the document

- Delete the document

- View the document's metadata – issuer, date, time, document type – but not its contents.

This means the user cannot read a refused document.

Once accepted, a document can be deleted but cannot be refused.

uDOC should protect users from receiving unwanted documents.

Example: the user bought a computer and the store keeps sending advertisements as documents.

uDOC should help the user avoid unwanted documents, annotations, and requests for documents.

2.21 Finding a User

uDOC helps to find a user.

DISCUSSION

To issue or transfer a document, the source user must inform the destination user's account.

Users can be found by their primary identifier, email, phone number, Line, Skype or any of the account's secondary identifiers.

See 2.9 Document Transfer.

See 2.22 uDOC Accounts.

2.22 uDOC Accounts

Users must create an account to use uDOC.

DISCUSSION

The user's account holds the user's information. The account is identified by a unique identifier – the account's primary identifier.

The account's primary identifier is an uDOC generated number. The primary identifier of an uDOC account cannot be changed and cannot be reused, even if the account is closed and deleted. The primary identifier is unique in uDOC: there is only one account with that identifier.

uDOC allows the user to associate one or more alternative identifiers - secondary identifiers - to the account. A secondary identifier should be something that the user probably knows by memory or can recover by checking other documents. Secondary identifiers are also unique in uDOC: there is only one account with a certain secondary identifier.

Typical secondary identifiers include the user's phone number, email, Line and Skype user ids and document numbers. If the user has many emails, all of them can be used as secondary identifiers, but once an email has been used as a secondary identifier to one uDOC account, it cannot be used as a secondary identifier to another uDOC account. A secondary identifier that was released or disconnected from one account can be used by another account. Secondary identifiers can be added, deleted, changed and reused, but cannot be used at the same time by different users.

Example: the user asked the equipment's receipt and warranty certificate to be sent through uDOC. The retailer sent the documents to uDOC using the user's phone number.

Example: the user opened an uDOC account using the phone number as a secondary identifier. After moving to another country, the phone number changed. The user replaced the old phone number by the new one. From now on, all documents sent to the new phone number will be stored at the user's uDOC. Documents cannot be sent to the old phone number until someone associates that old phone number to an account.

A source user can transfer a document to an uDOC account using the primary identifier or any of the secondary identifiers. However, if the source user wants to store the uDOC account key to send other documents without having to ask again for the keys, it is mandatory to store the primary identifier. This avoids sending documents to the wrong user in case the secondary identifier is deactivated from one user and later used by another user.

Example: the supermarket executed a one-time, ad hoc, transfer of a receipt to a destination user using the customer's email. As the supermarket is not storing the email for future transfers, there will be no problem if the customer changes the email. If the same customer returns to the supermarket in the future, the cashier will ask for the email again to send another receipt.

Example: The bank wants to send monthly reports to the customer. The bank records the uDOC account key to execute this operation every month. The bank must record the uDOC's primary identifier and not a secondary identifier. The bank may use a secondary identifier – an email, for instance – to recover the primary identifier. If the bank stored the phone number, for instance, it may send documents to the wrong uDOC account if the user changes the phone number.

See 2.9 Document Transfer.

The secondary identifier may be the subject of dispute between users. For instance, a user changed the phone number but forgot to delete that number from uDOC. Years later, the communications company released the same number to another user. The new user tried to use the phone number as a secondary identifier, but uDOC denied, informing that the number was already in use. In this situation, the user that owns the number can open a dispute.

Disputes over phone numbers, emails, Skype accounts and any other option that can receive a message are solved automatically. The user who claims to own that secondary identifier opens the dispute and proves the ownership by receiving a code. uDOC will send a notification to the other user reporting the situation and asking to either delete the disputed secondary identifier or send evidence that the claim is invalid.

Disputes involving secondary identifiers that cannot receive a message – a passport number, social security number, etc. - are not automatically resolved.

Initially, for operational reasons, uDOC accepts only secondary identifiers that can receive a message.

An account can be created in a scenario with multiple service providers.

See 3.11 Service Providers.

2.23 Multiple-Factor Authentication

uDOC supports multiple-factor authentication (MFA).

DISCUSSION

The user may opt to activate a multiple-factor authentication (MFA) to enhance the documents' protection and accessibility.

As one of uDOC's principles is to avoid the user losing access to the documents, MFA should consider contingencies and carefully balance accessibility and protection.

One option, for instance, is allowing the user to opt for two-factor authentication (2FA) that accepts any two combinations of:

1. Password.

2. Verification code sent via text message (SMS). uDOC should allow more than one phone number. uDOC discourages the use of SMS. SMS is dependent on the telecom operator, the contract, the network coverage, the user's location and does not work in all countries. If used, it can be one of the alternatives.

3. Verification code sent via email. uDOC should allow more than one email. Users should consider that some providers block the email account when the user is in a different country or using different equipment.

4. Verification code generated offline by the uDOC App at the user's smartphone.

5. Real-time authorization through the uDOC App at the user's smartphone – no need to type verification codes.

6. USB security key, which may also contain the user's private key.

7. One-time verification codes, generated by uDOC. They can be printed or the user can take a picture of them, for instance. Once used, the code becomes invalid. At any time, the user can revoke and generate new codes.

8. Pre-authorized devices, that need a verification code only once, for a specific period.

Factors 2, 4, 5, 6 and 8 are substrate-dependent factors. The others are substrate-independent factors. A substrate-dependent factor is dependent on a specific physical layer to be valid. For instance, a verification code generator app – factor 4 – is valid only if executed from the authenticated smartphone – specific physical equipment. A substrate-independent factor is not dependent on a specific physical layer to be valid. For instance, the code sent to an email – factor 3 - can be recovered using any equipment.

uDOC recommends the use of substrate-independent factors.

Even if the user loses all devices, including the smartphone, it is still possible to access the documents using, for instance, a password and a verification code sent by email.

Although users are free to choose the combination of factors that best fits their needs, uDOC strongly emphasizes the importance of having at least one option that allows access to the documents without the need of a substrate-dependent factor. For practical reasons, the everyday authentications may use substrate-dependent factors.

2.24 uDOC Dashboard

uDOC has a dashboard that presents statistics, graphs, and other information about the user's documents.

DISCUSSION

uDOC provides a dashboard that helps the user manage her/his account.

The dashboard may be used by the user to check if is there any unrecognizable access, to understand how the documents are being used, etc.

The dashboard contains:

- User statistics: number of documents, document types, issuers, oldest and newest documents, average age, smallest document, largest, average size, number of documents by issuer, by type, by issuer type, by format, etc.

- uDOC statistics: number of uDOC users and mostly the same as user statistics but for all uDOC users. Some uDOC statistics may be excluded depending on commercial or security issues.

- Expiration summary: a list of documents that will expire soon, statistics of documents with an expiration date, etc.

- Warnings summary: number and age of warnings, meantime the user takes to process or archive a warning, etc.

- Organisation summary: number of folders, models etc.

- Transfer summary: number of destination users, number of documents, type of documents, number of times a document was presented to another user, documents that can be deleted if the owner deletes his document, etc.

- Access summary: active authentication factors etc.

- Preauthorization summary: statistics and lists of preauthorized transfers, documents accessed by other preauthorized users etc.

- Special documents summary: statistics and lists of documents that can be deleted or revoked by other users, etc.

- Geographic distribution of the documents' origin, with basic GIS functions.

- etc.

2.25 uDOC Lists

uDOC supports public and private lists. Lists can be used by uDOC to authorize, deny, or parameterize operations.

DISCUSSION

A list may be certified and maintained by uDOC or by uDOC users.

Example: The country's official postal service – an uDOC user - manages a list of certified transportation and delivery companies. The user may choose to trust in this list and preauthorize any member to ask and receive the Home Address and Office Address.

Example: when creating a document, the issuer has to inform the Document Type. uDOC maintains a list of recognised Document Types.

A list can be public or private. All users can access a public list and only users authorized by the list owner can access a private list.

A list may contain other lists.

Example: the public list of Corporate Issuers contains the list of banks, utilities, airlines, schools etc.

A list can be exported and imported.

See 3.9 Document Certification by Other Users for more examples.

Example of uDOC lists:

- Object Types
- Document Types
- Public Schools
- Banks
- Utilities
- Airlines
- Government Agencies
- Corporate Issuers
- Country Calling Codes
- ISO 3166-1 alpha 2 Country Codes
- IATA Airport Codes
- uDOC users

If universally adopted, uDOC may also be useful as a repository for public lists. Instead of searching for lists in different organizations, using different interfaces and with different formats, users could access all lists in a single place, using a single interface and a standard format.

2.26 Document Metadata

uDOC keeps data that describes the document and the document's history.

DISCUSSION

The following list contains some document attributes that will probably exist to support the uDOC operations mentioned in this white paper. The objective is to help the understanding of some uDOC concepts and operations.

- Primary identifier: document's primary identifier, generated by uDOC when the document was created. Even if undesirable, for operational reasons the document's primary identifier may include the service provider's primary identifier that created the document.
- Secondary identifiers

- Issuer: the primary identifier of the issuer of the document. The issuer must be an uDOC user.

- Content: the document itself. uDOC accepts many formats: PDF, JPG, TIFF, DOCX, etc.

- History: a list of items. Each item has a type, date, time, description, parameters, and other observations for each operation executed on the document and other document-related events: create, archive, transfer, delete, annotate, revoke, attach etc. Creating the document is the first item in the document history. Accessing the document also creates an item in the history. Example: the user preauthorized all certified doctors to access the laboratory test results. The history contains the identification of all doctors that accessed those records. Not all items are visible to users or transferred when document ownership is transferred. The history structure is more than a simple log. It may be actively used to support some operations. Example: the issuer informed that the original bank account statement is wrong and sent a replacement. This operation is registered at the document's history. uDOC may use this information, for instance, to warn the user in all situations that the original account statement appears or to present a link to the new statement.

- Owner: the primary identifier of the document owner.

- Expiration date.

- Trace: informs if the document has trace on or off. See 2.9 Document Transfer.

- Hash code for the document content. The hash code for the document content can be used, for instance, to certify that the contents did not change or to issue a receipt for a document, even if it no longer exists.

- Hash code for the document metadata that cannot be updated.

- Hash code for other metadata.

- Transfer degree: See 2.9 Document Transfer.

- Transfer expiration date.

- Certifications: a list of certifications issued by users and authorities.

- Etc.

3. uDOC Special Features

3.1   Present a Document

uDOC allows a user to present a document.

DISCUSSION

This is a special case of transferring the document. The destination user can see the document, but once the document is closed or dismissed, it cannot be opened again. The presentation mode is also subject to a timeout, and the source user can manually cancel the document presentation anytime.

Example: the user is at the bank and must show the identity. The user will use uDOC to present the passport.

To present a document, the source user may open the document – at the smartphone, for instance - and generate a code – a QR code for instance – that can be read by the destination user. The destination user will use the code to recover the document and metadata directly from uDOC and not from the source user's device. The source user may be offline. The destination user must be online.

In a society with universal and reliable internet access, this should be the main alternative to present a document. The authority always checks the online version of the document, from a trusted source. There are no physical or substrate-dependent documents.

For less critical situations, the user may use the offline version of the document. The offline version of the document is substrate-dependent, valid only when presented by an authenticated smartphone or equipment.

See 3.2 Substrate Dependent Documents.

Example: at the movie theatre, the user must present the student's card. The user will use the smartphone to present the offline version of the student's card. There is no need to access the internet or to transfer a QR code to the authority. In this case, both the source user and the destination user may be offline.

See 3.3 No Need to Carry Documents.

3.2   Substrate Dependent Documents

uDOC encourages the use of substrate independent documents but supports substrate-dependent documents as a contingency.

DISCUSSION

uDOC promotes the use of substrate independent documents that can be accessed anytime and anywhere.

Nevertheless, uDOC also supports substrate-dependent documents such as a driver's license in a smartphone, a resident permit in a plastic card or a diploma in a special paper substrate. uDOC does this to help the transition from substrate-dependent documents to substrate independent documents.

See 1.6 Basic Terminology for substrate-dependent and independent documents.

There could be a service – approved and recognised by the government or other authorities – to convert a document stored in uDOC into a substrate-dependent version of the document – the physical document – that is recognised by the authorities.

Example: a university uses uDOC to store the student's diploma. Some companies require an original paper diploma in their recruitment process. The user may convert the uDOC online document into a paper diploma, with the characteristics approved by the university, in any authorized uDOC office.

uDOC helps the user: even if the issuer of the document does not have an office in the user's city, the user may obtain a physical version of the document in any uDOC authorized office. There is a single place to convert any document.

uDOC helps the issuer of the document: the issuer does not have to maintain or contract services to produce their physical documents. The issuer has to define the prerequisites and characteristics for the physical document and uDOC will produce the document accordingly to the specifications.

To make things simpler to the issuer, uDOC may offer standard profiles and prerequisites.

Example: a university defined that an uDOC diploma can be converted to Substrate Profile 7 (parchment paper, 25cm x 35cm, watermark type-2 etc.) using Requisites Profile 3 (as many times as the user requires etc.).

Example: The state defined that the identification card can be converted to Substrate Profile 3 (ISO-IEC 7810 ID3 etc.) and Requisites Profile 2 (First conversion: upon request by the user. After first conversion: the user must present the old document or must authorize the inclusion of the document in the database of lost documents).

Smartphone-based documents are another group of substrate-dependent documents that are becoming increasingly popular. It is usually implemented through a specific app, certified by the issuer – the government for instance – with encryption, codes, and other security measures. The problem for the user is that this approach is centred in the issuer. The issuer has one application for all users. Dozens of issuers mean that the user will have to install and use dozens of applications and interfaces. uDOC proposes a solution centred at the user: one application for all issuers.

The uDOC app for offline and smartphone-based documents can produce an offline version of any document stored in uDOC. Any substrate independent document can be converted into a substrate-dependent document that can be used offline – without internet connection – using a smartphone.

uDOC helps the user: there are only one app, only one procedure, and only one interface for any document, from any issuer.

uDOC helps the issuer: although the issuer has to approve the use of offline documents and audit the security measures adopted by uDOC, there is no need to develop, deploy, and support a new and specific application. Once uDOC implements a new security feature demanded by an issuer, this feature might be available to any other issuer. uDOC benefits from economies of scale.

3.3   No Need to Carry Documents

uDOC may be used to support official, government-issued documents.

DISCUSSION

What happens if the document is not at the place and time it is needed?

- No passport or id at the boarding gate

- No driver´s license when picking up a rental car

- No id at the bank

- No account statements when applying for a house rental

- No address proof when opening a bank account

- No documents at immigration

The user may suffer very negative consequences due to a forgotten, damaged, or lost document.

In a context where uDOC has government recognition, the users may be alleviated from these problems. It may be a huge advance for society.

In an uDOC society, services are no longer denied or refused to a person because of lack of a physical or substrate-dependent document. Even if the user lost all belongings, the documents are still in uDOC and can be easily recovered and presented.

For the following explanation, Person means the document holder, the person that wants to show a document. Officer means the person that asked the document. The Officer may be a police officer, the car rental employee, the person checking documents at the boarding gate or the immigration officer at a country border.

In an uDOC society, the Person has many options to present the required documentation to the Officer:

The Person may present the substrate-dependent document, i.e. the driver's license in a plastic card.

The Person may present an authorization to access the document. The authorization is a QR code. The Officer may read this QR code using the uDOC App to recover the online document.

The QR code may be generated by the Person's uDOC App, in real-time. The Person may also generate a PDF, a printed booklet or a digital album containing images of QR codes for selected documents.

All authorizations – QR codes – have a timeout. The Person can define the timeout. After the expiration, the QR code will not be recognised by uDOC. Usually, an authorization generated in real-time by the User's uDOC App has a timeout of a few minutes. A PDF or printed booklet may have a timeout of a few months. At any time, the Person can revoke the authorization. For instance, the Person may revoke the authorizations contained in a printed booklet lost during a trip. A person that found the printed booklet will not be able to access any document.

The presentation of the authorization instead of the document is the most reliable alternative, but at least the Officer must have internet access.

If the Officer does not have internet access to check the online document, the Person may use the uDOC App to present an offline version of the document.

The Officer may trust in the version presented by the Person or may opt to use the uDOC App to certify the document, based on offline generated codes. It is not as reliable as the online option but is faster and does not need an internet connection.

All documents that the Officer checked offline are recorded by the uDOC App. When connected to the internet, uDOC will automatically check the documents and report any problems. It may be too late to refuse the service to the Person that presented an invalid document, but it may help the Officer to take additional measures.

If the person has no smartphone, no printed authorizations, and no PDF, it is still possible to present the document if the person has access to the internet, using a third-party infrastructure. As it may require more time and resources, the regulation may determine measures to discourage this option. For instance, the airline may charge a fee for the passenger to use the airline's computers to generate a QR code.

Only if the person has no smartphone with uDOC, no printed authorizations, and there is no infrastructure to access the online uDOC, it will not be possible to present a document.

As this situation can be easily remedied, it is expected that there will be fewer situations when a service is denied because of lack of documents.

Example: The police officer asked a driver to present the driver's license.

1. If the driver has a plastic card driver's license, the police officer will check it as usual.

2. If the driver does not have the plastic card driver's license, the smartphone with uDOC will be used to present an uDOC QR code of the driver's license. The police officer will use his equipment – a smartphone, for instance – to read the QR code and access online the uDOC driver's license with all certificates. This is the most reliable alternative to check a document.

3. If the police officer does not have internet access at that moment, the driver will show the uDOC image and codes of the driver's license, and the police officer will use his equipment to offline check if the image is authentic. It is not as reliable as option 2 but it may be used as a contingency. All documents that the police officer checked offline can be automatically verified when the officer's smartphone becomes online. Any discrepancies will the appointed by uDOC.

4. The driver lost his smartphone. In this situation, the driver will have to access uDOC using any equipment with access to the internet and present the driver's license. The driver may use, for instance, the smartphone of any of the passengers or even the police officer's device.

5. The driver could not use any equipment to access uDOC but has a printed QR code of the driver's licence. With internet access, the police officer can use this QR code to check the document.

6. If the driver has no smartphone with uDOC, no QR code printed, and cannot access any equipment with internet access, the driver will not be able to present the driver's license.

Ultimately, in an uDOC society, there will be no need to carry any kind of document. For practical reasons, a smartphone or even a printed booklet may be used, but they are not mandatory.

In a utopian world, a person will be able to cross borders without a physical passport or any kind of document or equipment, if both governments recognise uDOC.

We are already in transition to digital documents. There are government initiatives to allow persons to present documents using some of the alternatives presented in this discussion. Each initiative may demand a specific application and the Person must learn how to use each one of the interfaces. Each agency must develop or at least choose the technology that will support its documents. With uDOC, all documents are presented, stored, and certified using a single platform. There is one platform for all documents, instead of one platform for each type of document.

There may be the need to adapt the legislation and infrastructure. Nevertheless, the potential benefits for society are so huge that it is worth to consider its adoption.

3.4   Request a Document

An uDOC user can request a document to another uDOC user.

DISCUSSION

Using uDOC, a User A can request a document to a User B.

The User A can request only transfers without ownership and with revoke clause on.

See 2.9 Document Transfer.

If the User B authorizes, the document will be transferred to the User A.

The User A can send the request using any of the account keys – primary or secondary.

The User A can present the request using a QR Code.

Example:

The police officer stops a driver and presents a QR code. The driver uses his device to read the QR code. uDOC informs that a user identified as a police officer is requesting the driver's license. If the driver authorizes, uDOC will execute the transfer.

3.5   Document Trace

uDOC allows the owner of a document to locate all copies and trace them.

DISCUSSION

Example: The User A created a curriculum vitae and sent it to other users. The result of a document's trace could be:

The document was sent to:

- 2019-12-07   09:12:17   Document transferred to User A, without ownership.
- 2020-01-15   17:21:54   Document transferred to User B, without ownership.
- 2020-01-15   17:23:12   Document transferred to User B (Pointer).

If the document was transferred with TRACE ON, uDOC is also able to produce a more detailed document trace:

In 2020-02-02 17:07:13 the document can be found with:

- User A (Owner)
- User B
- User E

1. 2019-07-16 17:33:17 User A issued the document.
2. 2019-07-20 09:47:05 User A transferred a copy of the document to User B.
3. 2019-07-27 15:12:55 User B downloaded the document.
4. 2019-12-03 10:01:34 User B transferred a copy of the document to User C.
5. 2019-12-03 10:02:15 User B transferred a copy of the document to User E.
6. 2019-12-03 10:03:12 User C transferred a copy of the document to User E.
7. 2019-12-03 10:03:52 User C deleted the document.

The trace returns only information that refers to where the document is. It does not return information regarding other operations such as opening or reading.

When transferred, the destination user is informed that the document came with TRACE ON, meaning the owner of the document can trace it.

The source user can specify if TRACE is ON or OFF when executing a document transfer.

Once transferred, the source user cannot enable TRACE ON.

Once a document is transferred with TRACE ON, subsequent transfers will also be TRACE ON. The destination user cannot disable the trace.

Only the document owner can execute a trace operation.

3.6   Document Group

uDOC allows a document to be part of another document.

DISCUSSION

The user can create a document that contains other documents. The user becomes the issuer of the main document, but uDOC preserves the original issuer of the other documents.

Example: the user wants to send the documentation to apply for a VISA. The documentation will be sent through uDOC and is composed by a presentation letter, an electricity bill with address, the last three payslips, the job contract, and the last three account statements. The user can opt to group all documents in a single document. The consulate can verify the certification of each document. The main document may be the presentation letter. The issuer of the presentation letter is the user, and this presentation letter can include other documents.

Each included document keeps its metadata.

When the main document is transferred, all included documents are also transferred.

When the main document is archived, the included documents are NOT archived.

When the main document is deleted, the included documents are NOT deleted.

Only the document owner can ungroup a document.

3.7   Document Connections

uDOC allows connections between documents.

DISCUSSION

Example: the credit card statement shows some expenses that are related to receipts. One item refers to the purchase of a computer. The user may want to connect the receipt of the computer, with details of the purchase, to the credit card statement item.

Example: an electricity bill was paid using a bank account. When the user opens the account statement and sees an item, he can open the connected document, e.g. the electricity bill. If the user opens the electricity bill, it is possible to check how the bill was paid, opening the connected account statement document.

uDOC tries to connect documents after automatically analysing the documents' content.

Example: uDOC automatically connected a restaurant receipt to a credit card statement item that has the same date and value. Although the receipt does not contain the number of the card, it states that a credit card was used for payment.

uDOC allows the user to connect or disconnect documents manually.

uDOC explains to the user why two documents are connected: the documents were manually connected or which evidence uDOC used to consider that the two documents should be connected.

uDOC may identify items in a list that have no connecting documents.

Example: which are the credit card statement items that have no connected receipts?

3.8 Document Comparison

uDOC allows a user to compare two documents.

DISCUSSION

uDOC compares two or more documents and informs:

- Document fields that do not appear in all documents.

- Document fields, including metadata, with different values.

- Documents with different formats and similar content.

The document fields are defined by uDOC after analysing the documents' content. They may be in different formats.

Example: the bank revoked an account statement due to an error and sent another statement. The user may use uDOC to compare the revoked and the new statements and discover what changed.

Example: the landowner sends a new contract for the house rental. The user may use uDOC to verify what changed from the original contract.

Example: one document is in PDF format, and the other is a scanned version of the document. uDOC will execute an OCR before comparing the documents.

Example: Document A is an older version of the driver's license. The category – motorcycle, car, bus, etc. – was referred to as Type. Document B is a driver's license that uses the new format and mentions Category instead of Type. uDOC compares Document A and B and may inform that the format, size, and field names are different but the contents, except for the date of expiration, seems to be the same. In this case, uDOC understood that Type and Category hold the same information.

3.9 Document Certification by Other Users

uDOC allows a document to be certified by other uDOC users.

DISCUSSION

All documents are automatically certified by the issuer. In some situations, an authority may demand certification by other users.

Certification is the process where a user attests that the document's content is correct.

Any uDOC user may ask another uDOC user to certify any document.

Example: the student wants to study at a university abroad. The university asked the high school diploma to be certified by the consulate. The student – an uDOC user – asked the consulate – another uDOC user – to certify the diploma. The consulate informed the student that it recognises only certifications issued by the Department of Education, as the consulate does not know all schools. The student then asked the Department of Education – also an uDOC user - to certify the diploma. As the Department of Education knows the school, it issued the certification. The student then asked the consulate to certify the diploma. The consulate certification was issued after it recognised the Department of Education's certification. In the end, the document – the diploma – had three certificates:

- Certificate #1: issued by the school, not recognised by the university.

- Certificate #2: issued by the Department of Education, not recognised by the university.

- Certificate #3: issued by the consulate, recognised by the university.

Certification can use trusted lists. See 2.25 uDOC Lists.

Example: to simplify the process, the Department of Education created and certificated an uDOC list containing all schools that it recognises. After that, the consulate began issuing certificates for any diploma issued by a school in the Department of Education's list.

After negotiations between the governments of the two countries, all universities begin to accept any diploma with a certification issued by a school in the consulate's list. The consulate list was connected to the Department of Education's list. All schools recognised by the Department of Education were automatically recognised by the consulate because the consulate trusts the Department of Education. All schools recognised by the consulate were automatically recognised by the universities because the universities trust the consulate.

See 2.11 Document Certification.

3.10 uDOC and Address

uDOC helps to manage the user's addresses.

DISCUSSION

In some situations, a person must disclose the address to an employer, a government agency, a bank, or a retailer to be eligible to services or to receive mail or goods.

When a person moves to a new house or office, it may be necessary to update the address in many different places. Even months after the person moved, some mail might still be delivered to the old address.

Instead of registering the address in different organisations, the user may register the address once at uDOC and authorize others to check the address. If the address changes, there is a single place to update it: uDOC.

The user may not be comfortable disclosing the real-world address. With uDOC, the user may disclose only his uDOC address.

Example: The retailer asked the user's address to deliver a package. Instead of informing the full address, the customer informed only the uDOC Address. The retailer sent the package to the uDOC Address. The transportation company converted the uDOC Address into a full real-world address and delivered the package. The retailer was able to send a physical package without knowing the user's address.

uDOC helps:

- the user: if the user moves to a new house, there is only one place to update: uDOC.

- the sender: the sender's database records the uDOC Address, instead of a full address supplied by the user, sometimes wrong, misspelt, incomplete or not standardized. If the sender wants to send another package after the user changed the address, the package will not return due to an unknown recipient. The postal service will convert the uDOC Address to the new real-world address.

- the postal service or the transportation company. For transportation companies, it will be easier to process addresses. The uDOC Address is standardized and may be easier to decode and georeference using a computerized system.

uDOC may help but is not a complete solution for users concerned with privacy regarding the address. There will be many users – public and private postal services, transportation and delivery companies – that will be preauthorized to convert the uDOC Address into a real-world address.

The user may authorize uDOC to answer basic questions about the address without disclosing the full address: country, region, if the address is serviced by the postal service, etc. uDOC should supply sufficient information to allow a sender to calculate delivery times and costs, for instance.

The user may authorize uDOC to certify an uDOC Address. A certificate may attest, for instance, the number of conversions of the uDOC Address into a real-world address in the last twelve months. Although it does not prove that the real-world address exists, it may be evidence that the user uses that address.

Example: uDOC certifies that 3 banks, 2 government agencies, and 12 retailers converted the user's uDOC Address into the real-world address in the last twelve months.

The uDOC Address may be certified by the Government or by a third party. Certified uDOC Addresses may be used as a proof of address.

A user can have more than one address: home, office, beach house, etc.

Example: the user bought a cupboard and wants it to be delivered to the beach house. The beach house address is registered at uDOC as Address 5. The user requests the retailer to send the cupboard to uDOC Address 5.

The user may preauthorize the transfer of the address to all users in an uDOC List. The list may contain, for instance, all transportation companies and postal services.

See 2.25 uDOC Lists.

3.11 Service Providers

uDOC may be supported by different service providers.

DISCUSSION

uDOC may be offered by different service providers. Users may choose the service provider that best fits their needs. Documents are interchangeable between service providers. Users can easily move their documents from one service provider to another. Users may use more than one service provider at the same time. For instance, the user has business in two countries and opted to keep the documents in two different service providers.

All service providers must adhere to the uDOC standards. These standards still do not exist.

The uDOC Platform integrates all service providers and is responsible for basic services such as:

- Informs the service provider used by a given user. If someone wants to issue or transfer a document to a user, the uDOC Platform informs to which service provider the document should be sent. As users may use more than one service provider, they may define the preferred service provider. For instance, a user may inform that bank documents should be sent to Provider A and health documents should be sent to Provider B.

- Generates a primary identifier when the user is creating an account. The primary identifier is unique in the uDOC Platform. If the user has accounts in different service providers, all providers will use the same primary identifier for the same user account. See 2.22 uDOC Accounts.

- Stores the user's organisational models. Users may create their organisational models in a single place. By default, any organisational model is valid for all service providers. A user may create an organisational model that is valid only for a specified service provider.

- Transfers documents from one service provider to another. All certifications and metadata unrelated to the service provider are preserved.

- Synchronizes documents between two or more service providers to enhance documents availability.

- Generates a primary identifier for the documents. For operational and performance reasons, the uDOC Platform may be unable to support the generation of document primary identifiers. In this scenario, one alternative is to include the primary identifier of

the service provider in the document's primary identifier and let the service providers generate the document primary identifier.

- Returns the account primary identifier if the source user informs any secondary identifier.

Although the uDOC standards define a set of mandatory services, each service provider may offer non-standard or non-mandatory features. Example: Provider A offers a free basic account without OCR and AI processing. Provider B offers a free account for up to 10.000 documents with OCR and AI processing.

Authorizing service providers to offer non-standard features is important to promote the evolution of uDOC. A non-standard feature may be standardized and even become mandatory.

For privacy, reliability, and availability, it may be preferred to have service providers that do not depend on a single, central uDOC Platform. In this case, uDOC would be only a standard and not a platform. Some concepts mentioned before should be adapted to a context with no centralized control. For instance, a transfer operation should include not only the destination user's account but also the service provider. Each service provider would control its primary identifiers.

3.12 uDOC Super User

With uDOC, users can be connected to other users to manage documents in a large organisation.

DISCUSSION

For a more complex structure – a company instead of a single user, for instance – uDOC allows the creation of a superuser.

All documents that belong to users connected to a superuser also belong to the superuser.

The superuser has at least two special vaults:

- All users connected to the superuser can read the documents in Vault 1.
- All users connected to the superuser have the same rights of the superuser on documents in Vault 2.

A superuser can be connected to other superusers.

3.13 Zero-Knowledge Inquires

uDOC is not a zero-knowledge inquiry system, but it can help preserve the user's privacy.

DISCUSSION

Sometimes users are asked to present documents to prove something. Documents may contain a lot more information than what is requested.

uDOC may help the user to protect his privacy.

Example: the user wants to rent a car. The car rental needs to know if the user is qualified to drive the car and if the driver's license is at least two years old. Instead of presenting the driver's license, the car rental will submit these conditions to uDOC and uDOC, after the user's authorization, will answer YES if ALL conditions met and NO if ANY conditions are not met. There is only one answer no matter the number of conditions.

It is still possible to infer the driver's license information if the car rental submits the right set of questions, but it may reduce some privacy issues.

3.14 Zero-Knowledge Mode

uDOC may operate in a zero-knowledge mode.

DISCUSSION

Although the documents are always transferred and stored encrypted, uDOC considers two alternatives for managing the user's documents:

1. uDOC knows the user's key and uses this key to encrypt all documents. uDOC can open and process the document's content and not only the metadata. This option allows the user to access the documents using a browser, allows uDOC to organise documents in the cloud and uDOC automatically can generate new metadata using AI. It is very convenient to the user, but for uDOC to have access to the documents' content, the user has to trust the uDOC's privacy policy. This solution is simpler to understand and easier to implement. If the user loses the key, it is technically possible to recover it with the support of the uDOC Platform. This option uses symmetric encryption.

2. All documents are encrypted using the user's public key. uDOC cannot open and process the documents' content. The user cannot access the documents online using a standard browser. To organise documents or generate new metadata based on the document's content, uDOC provides applications that should be installed at the user's equipment – a device running Windows, Android or iOS, for instance. All processing happens at the user's device, using the user's private key. In this situation, if the user loses the key, there will be no option to recover the documents using the uDOC Platform. The user will lose access to all documents and will have to use a non-encrypted backup for restart and recovery. The application's code may be opened for public scrutiny to reduce the risk of uDOC misusing the private key or the document's content. Users must have at least a basic understanding of the importance of preserving the private key. This option offers better privacy to users, as neither uDOC Platform nor the service providers will be able to access the documents, even if they are forced to do so. This option uses asymmetric encryption.

In both cases, an attacker with access to the documents repository will not be able to read them without the user's key.

Besides the technical protections – encryption, zero-knowledge – there is non-technical protection that may be also strong: the whole model of uDOC depends on the trust of the user in

the service. If uDOC intentionally decides to fraud the user's documents or if uDOC does not invest in data protection and privacy, it is risking the existence of the service.

4. Final Discussions

4.1   Potential Benefits, Results, Effects, Impacts and Outcomes

A full uDOC implementation depends on technological development, legislation and cultural changes, and a sustainable business model. There are many obstacles, but the potential effects, impacts and outcomes for the society may justify further development of the uDOC basic ideas presented in this white paper. In an uDOC society:

- There is no need to carry a document. You access or present a document, but you do not carry it.

- No service would be denied due to a forgotten, lost, or damaged document.

- Less false documents.

- Users do not look for documents - documents look for the right user.

- Users do not spend time organising documents – documents are automatically organized as soon as they are issued.

- Documents warn users when they are going to expire or when it is necessary to take some action.

- Users change their address in a single place - no outdated addresses.

- Users can access their documents anywhere, anytime.

4.2   Private or Public Service?

A basic version of uDOC – to organize bills, statements, receipts, etc. – can be a private service. However, to maximize the benefits, uDOC should be recognized by the government and include official documents – driver´s license, diplomas, car documents, house deed, resident's permit, etc. Even if it is a public service, it will probably be supported by providers from the private sector.

In a full implementation scenario, it is also important to have many service providers: important documents should not rely on a single company. Besides, competition leads to evolution and cost reduction.

The same rules apply both for private or public cases: only the document owner can delete a document and no private or public entity can revoke the certifications. Even if a document is revoked by the government, only the owner can delete it and uDOC will continue to issue the document's certificates.

If the government of a particular country no longer exists, all documents that belong to the citizens are preserved. uDOC should not be under the authority of any particular government. In a utopian scenario, uDOC should be non-commercial and regulated by a supra-national organisation. This would also promote intergovernmental acceptance: for instance, a passport issued by one country would be recognized by other countries.

4.3   Restart and Recovery

If a service provider no longer exists, the user should be able to easily recover and transfer the documents to another service provider. uDOC should provide backups, real-time synchronization with an alternate service provider or the user's storage – a computer or cloud service, for instance.

4.4   Universal Service

uDOC should be a universal service. Anyone, even those who cannot pay, should have access to the service. This may accelerate the adoption of the service and may convince governments to recognize and support uDOC.

One option is to offer free basic services for a limited number of documents or limited storage. Special services and a larger number of documents could be charged. A similar model is adopted, for instance, by cloud services providers.

4.5   Proof of Concept and Pilot

uDOC basic functions could be implemented in a controlled environment – a university for instance – as a proof of concept (PoC), to demonstrate its feasibility, and to verify that these ideas have practical potential. As it involves different areas, the PoC could be conducted by a team with knowledge related to:

- General Data Protection Regulation
- Privacy issues
- Information and Communications Technology (ICT)
- Unified Modelling Language (UML)
- Software Engineering
- Cloud Computing
- Cryptography
- Artificial Intelligence (AI)
- Blockchain
- Semantic Web
- Big Data

4.6   Privacy and Data Protection

The question of privacy and data protection is one of the most important since uDOC will contain a high amount of personal data, including sensitive data. To ensure a high level of protection of

the stored personal data, uDOC must comply with the applicable data protection regulations, rules, standards, and principles. The aim is to ensure a high level of data security, integrity and confidentiality of the collected data while respecting all data subjects (individuals/citizens) rights concerning their right of protection of their data. For that purpose, an information security management system must be in place and must include a set of policies and procedures for the management of the protection of all data, including sensitive data. In addition, a mandatory Data Protection Impact Assessment to provide risk assessments must be conducted before the rollout of the uDOC service. The same assessment should be conducted for upgrades with new features and services or when using new technologies. The assessment will provide a detailed overview of the technical and organisational measures that must be in place to ensure an adequate level of data protection. Moreover, the principles of Privacy by Design and Privacy by Default must be implemented during the uDOC design stage and must be mandatory for all further upgrades.

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