# Propuesta de una arquitectura para la gestión de información personal en entornos móviles

*Proposal of an architecture for the management of personal information in mobile environments*

*Propôs uma arquitetura para o gerenciamento de informações pessoais em ambientes móveis*

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## Resumen

La información juega un papel primordial para la toma de decisiones en las organizaciones e inclusive la vida cotidiana. Actualmente, personas y organizaciones disponen de sus datos en forma física o digital, siendo administrados mediante diferentes protocolos, aplicaciones y sistemas como bancos, nóminas, redes sociales y bases de datos por mencionar algunos; en todos los casos se cuenta con algún nivel de protección y confidencialidad para asegurar la integridad y coherencia de la información, además de la existencia de arquitecturas orientadas a la comunicación y compartición de datos entre sistemas. Sin embargo, aún no

se logra una interoperabilidad total entre los mismos de forma que sea posible la compartición de información de forma segura y transparente a los usuarios.

En el presente artículo los objetivos serán: 1) Realizar un análisis de las arquitecturas existentes, 2) describir el proceso de diseño de una arquitectura que se propone para la gestión de información personal y, 3) determinar las funcionalidades de cada etapa. La investigación es de carácter descriptivo de acuerdo a los objetivos planteados y para la construcción de la arquitectura se siguieron los pasos del método científico.

Los resultados obtenidos se resumen en la generación de una arquitectura que se presenta como una guía para el desarrollo e integración de sistemas dedicados a la gestión de información personal de usuarios. Se obtuvo una arquitectura basada en estándares de presentación y manejo de datos, así como implementación de mecanismos y servicios de seguridad, por lo que esta arquitectura garantiza una adecuada administración de la información, de forma que la misma se encuentre siempre disponible favoreciendo su movilidad y ubicuidad.

Palabras clave: Arquitectura, Cómputo Ubicuo, datos personales, datos sensibles, Gestión de Información, procesos organizacionales.

## Abstract

Information has a fundamental role for decision-making in organizations and even daily life. People and organizations now have their information in physical form (official documents) or digital (digital photographs or pdf documents) and are managed through different protocols, applications and systems such as banks, payroll, social networks and databases to mention someone's in all cases there is some level of protection and confidentiality to ensure the integrity, consistency and completeness of the information, in addition to the existence of architectures oriented to the communication and sharing of data between systems. However, complete interoperability between them is still not achieved in a way that is possible to share information in a secure and transparent method to users.

In this article the objectives are: 1) Perform an analysis of the existing architectures, 2) describe the process followed in the design of an architecture that is proposed for the

management of personal information, and 3) determine the functionalities of each stage. The research is descriptive in accordance with the stated objectives and for the construction of the architecture the steps of the scientific method were followed.

The results obtained are summarized in the generation of an architecture that is presented as a guide for the development and integration of systems dedicated to the management of personal information of users, not only of mobile devices to promote ubiquity, but of any type of system Computer science. An architecture based on standards of presentation and data management, as well as implementation of security mechanisms and services, was obtained, so that this architecture guarantees an adequate administration of the information, so that the information is always available favoring its mobility and ubiquity.

Key words: Architecture, Ubiquitous Computing, Personal Data, Sensitive Data, Information Management, Organizational Processes.

## Resumo

Informação desempenha uma chave para a tomada de decisão nas organizações e inclusive vidas diárias. Atualmente, indivíduos e organizações têm seus dados em forma física ou digital, a ser gerido por diferentes protocolos, aplicações e sistemas, como bancos, folha de pagamento, redes sociais e bases de dados para citar alguns; em todos os casos ele tem algum nível de proteção e confidencialidade para garantir a integridade e consistência da informação, bem como a existência de arquiteturas orientadas a comunicação e partilha de dados entre sistemas. No entanto, mesmo a plena interoperabilidade entre eles, para que possível a partilha de informação forma segura e transparente aos usuários não é alcançado.

Neste artigo, os objetivos são: 1) Realizar uma análise da arquitetura existente, 2) descrever o processo de concepção de uma proposta para a arquitetura de gerenciamento de informações pessoais e, 3) para determinar a funcionalidade de cada etapa. A pesquisa é descritiva de acordo com os objectivos e etapas arquitetura do método científico é seguido.

Os resultados são resumidos na geração de uma arquitetura que é apresentado como um guia para o desenvolvimento e integração de gestão de pessoal usuários de sistemas de

informação dedicados. foi obtida uma arquitetura baseada em padrões de apresentação e gerenciamento de dados e implementação de mecanismos e serviços de segurança, de modo que esta arquitetura garante a gestão da informação adequada, de modo que é sempre disponível mobilidade favorecendo e onipresença.

Palavras-chave: Arquitetura, Computação Ubíqua, dados pessoais, dados sensíveis, gestão da informação, processos organizacionais.

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## Introduction

Several organizations are in a moment of transition due to the technological advances that have arisen in the last years. Its own growth has also led to changes in business requirements, so it has been necessary to migrate its systems and services in order to implement more complex systems. Since it is essential for the decision making in an organization to know the information in real time, the management of it is a key part of the design of the applications and computer systems.

The purpose of mobile computing is to treat information by means of "computing devices with mobility capability and with digital access to information sources via a communication infrastructure" (Guzmán, 2012), making it a great tool Which is the driving force of organizations to optimize and enhance the management of business information, especially confidential information, since various types of mobile devices and applications are available to capture, query and store information dynamically from anywhere, Without having to continue tied to the static centers of computation, according to the one indicated by Medina, (2012).

This article is organized as described below. In the first part, referring to the context, there is a brief introduction to mobile computing and its integration into people's daily life, as well as the current organizational information management needs. Subsequently the problem is

introduced, which gives rise to the need to generate global information management processes and then present the research objectives. In the methodology section the research method is presented, which corresponds to the scientific method. In the first stage, an analysis of the existing structures is performed, the interoperability between information management systems is reviewed, and in the results section, the processes and functions required for each of the 6 Layers are presented. Correspond to the proposed architecture that is characterized by allowing the development and interoperability between systems dedicated to the management of personal information. The conclusions and future directions of the work are described in the last heading.

## Context

At present, information has become a fundamental part of most processes in various economic, productive and social sectors. With regard to personal information, a number of technological tools have been developed for their management and sharing, which must adhere to legislation and protocols that determine their management, distribution and protection.

With the intention of adapting to the technological changes of the current digital era, organizations have made strong investments in software applications to support their business processes. The infrastructure that is implemented according to the requirements is usually heterogeneous through a number of platforms, operating systems and applications developed in different languages, regularly generating redundancy and overlap in functionality and services, resulting in a waste of valuable resources, Generating inadequate response times. Business and information technology managers implement architectures to develop solutions that eliminate the aforementioned disadvantages and be able to work collaboratively to share information within an organization.

In order to adapt to the technological needs and organizations of today, it has not yet been possible to reach a desirable standard architecture, due to the disadvantages presented by the architectural schemes that are listed below:

a. The integration of an architecture adds greater complexity in terms of network latency, message format, load balancing and fault tolerance.

b. Complex meta-data management.

c. Complex management of security levels.

d. There are no robust tools for testing.

e. Lack of horizontal trust on the part of the organizations in the implementation of architectures.

f. The information requires data formatting increasing processing and response times.

g. Data consistency is not completely secure.

## Research Problem

The information systems of the organizations have at least one area dedicated to the administration of the information, since it must be available at all times. Organizations have been adapting their organizational infrastructure to the integration of mobile solutions (Medina, 2012). However, there is still a huge gap on the possibilities of using mobile computing for the management of confidential personal information, so it is proposed to design a Personal Information Management Architecture that allows information sharing between organizational systems, through Different devices, regardless of their infrastructure characteristics.

**Goals**

1. Perform an analysis of existing architectures.

2. Describe the process followed in the design of an architecture that is proposed for the management of personal information.

3. Define the functionalities of each layer that integrates the proposed architecture.

**Hypothesis**

The layer model for building the architecture allows for interoperability between systems.

## Methodology

This section describes the process followed to reach the proposed objectives and with it to solve the problem raised, for which the research was based on the scientific method.

In the first stage we work on what is indicated in the first objective, since an analysis of the existing architectures is done, and according to the characteristics found a first classification is made; We continue with a second classification, but this only considers process-centric architectures. At this stage, information management characteristics are also reviewed, which are addressed by the personal information systems most commonly implemented today.

With the second stage of the method, it is sought to reach the second objective, which is why the design of the architecture is proposed by the construction of 3 layers. To finish this part of the methodology the workflows relative to each layer are determined.

**Stage 1. Analysis of existing architectures**

In the quest to make the processes of information management and interoperability between systems more efficient, there have been developments under various architectures, depending on the infrastructure possibilities as well as the hardware and software tools available. Figure 1 shows the evolution of the architectures in computer systems, corresponding to advances in hardware and communications.

**Figure 1.** Evolution of computational architectures.

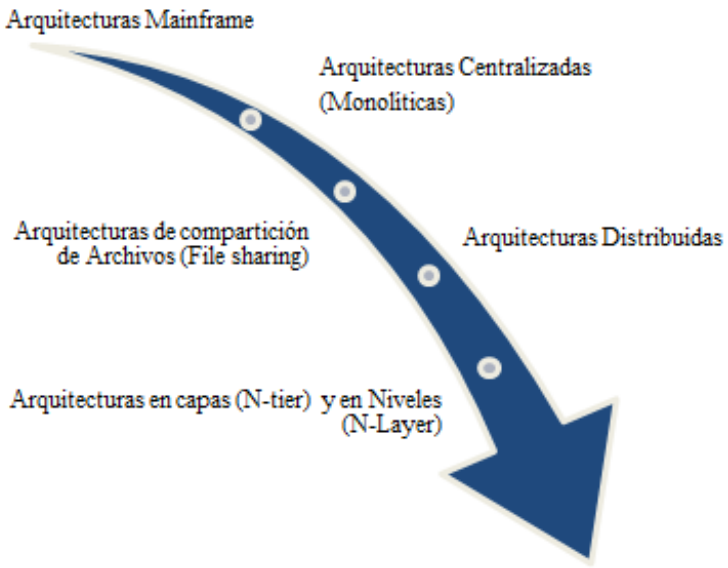



Table 1 summarizes the most relevant aspects of each of them.

**Table 1.** Architectures Features.

| Arquitectura | Características |
|---|---|
| Mainframe | Procesos centralizados.<br>Dependencia total del Mainframe para llevar a cabo los procesos.<br>Terminales brutas (No poseen CPU).<br>No soporta GUI.<br>No es Cliente/Servidor. |
| Centralizada | Monolítica (Consta de una máquina, un proceso y un usuario).<br>No existe ninguna posibilidad de concurrencia.<br>Requiere de dispositivos externos para compartir información. |
| Compartición de Archivos (File-sharing) | Una máquina comparte recursos (archivos) y una terminal realiza peticiones sobre los recursos y trabaja sobre ellos.<br>Los procesos se realizan en la terminal que solicitó el servicio.<br>Terminales inteligentes.<br>Soporta GUI.<br>Bajo nivel de tráfico, archivos pequeños, pocas actualizaciones.<br>Bajo nivel de concurrencia (12 usuarios máximo) |
| Distribuida | Permite implantar sistemas colaborativos en la web.<br>Mayor aprovechamiento del hardware y ancho de banda.<br>Mayor seguridad y autonomía.<br>Manejo de concurrencia.<br>Permiten que los clientes trabajen GUI mientras el servidor se centra en otros procesos. |
| En Capas | Separación en componentes dedicados a una labor en particular favoreciendo la distribución de procesos y roles. |

Due to the great growth of Internet applications, Layer Architecture (Zimmerman, 1999 and Mora, 2011) has been widely implemented. However, to remain competitive, organizations must be agile in adapting their business processes, as well as the changes that are generated in the environment, therefore, increasingly have focused on processes, which means that The activities carried out by organizations are being structured as processes. Given this situation, organizations have developed a variety of strategies to understand and formalize their processes, as well as keep their documentation up-to-date, with the tendency to design

components for general use, taking into account their properties of being reused and shared between Multiple applications.

**Process-centric architectures**

Table 2 shows a comparative table about the characteristics of process-based architectures for current organizational systems.

**Table 2.** Comparison Chart of Characteristics of Process-Centered Architectures.

| Arquitectura | EIA | BPA | EDA | PA | SOA |
|---|---|---|---|---|---|
| Gestión de procesos de negocio | X | X | X | X | X |
| Reingeniería de procesos de negocio | X | X | | X | X |
| Interoperabilidad | X | | | X | X |
| Reutilización de componentes de software | X | X | X | X | X |
| Portabilidad (Independencia de software y plataforma) | X | X | X | X | X |
| Procesos centrados en la Gestión de la Información | | | | | |
| Procesos centrados en el cómputo ubicuo | | | | | |

EIA (Miranda 2002, Brancheau y Wetherbe, 2002), BPA(Ahmad, Odeh 2012), EDA (Lapouchnian A, Yu y Sturm,2015), PA (Moreno, 2015), SOA (Pesantes, Mitre y Mejía 2012).

**Personal Information Management Systems**

Since the adoption of computer systems to facilitate the management of information in organizations, Personal Information Management Systems (PIMS) have been a basic element of any organizational system (Ruan, Zhang, Hua, 2010 ).

The PIMS have been developed according to the type of information they manage, for example, Rustom, Nasar, Mohd and Ali (2011a and 2011b), have deepened the study of user interfaces in PIMS and their characteristics to allow users Interact with your personal information. On the other hand, in an article published by the same authors (Rustom, Nasar,

Mohd, Ali, 2011a and 2011b) reference is made to the management of photographic and video images from the study of the life cycle of a PIM system, Highlights features such as ubiquity and information management.

In the business world, mobile enterprise solutions PIM, are used to improve the management of personal information of employees. According to Kamesh (2011), PIMs are those solutions that allow employees to increase their personal productivity by using mobile devices that run applications for handling personal information such as calendars, contact managers, event planners, alarms, mail Electronic, etc.

Table 3 shows a comparative table on the information management characteristics addressed by the personal information systems most widely implemented today.

**Table 3.** Comparison table of PIMS characteristics.

| ArquitecturaPIMS | EIAEmpresarial | BPAMultimedia | EDAGestión administrativa personal | PAEntretenimiento |
|---|---|---|---|---|
| Gestión de procesos de negocio | X | X | X | X |
| Reingeniería de procesos de negocio | X | X | | X |
| Interoperabilidad | X | | | X |
| Reutilización de componentes de software | X | X | X | X |
| Portabilidad (Independencia de software y plataforma) | X | X | X | X |
| Procesos centrados en la Gestión de la Información | X | X | | X |
| Procesos centrados en el cómputo ubicuo | | X | | X |

**Stage 2. Design**

The architectural design presented focuses on information. The nucleus of information of interest is the one corresponding to the personal trajectory of an individual, which is characterized by the unit or object immersed in a series of computational elements that allow to carry it and in general, to administer it at all times (availability) and In every place (ubiquity). The structure of the object is shown in Figure 2:

**Figure 2.** Basic Structure of Personal Object.

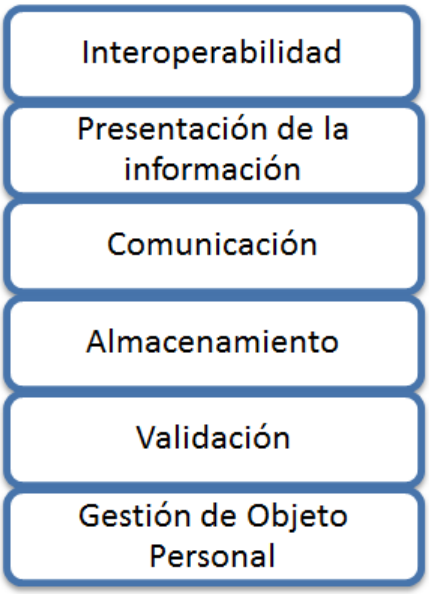

CURP (Clave Única de Registro de Población).

This object is the basis of a broader design of elements that make up the trajectory of a person. On the other hand, this object is immersed in a digital ecosystem (Kamesh, 2012), where the necessary means must be provided to carry it (mobile device) and endow it with the capacities to be shared (interoperability).

The architectural design contemplates that in the ecosystem each element coexists with others that will allow to manage the information in a coherent, effective and safe way. For this purpose, the architecture has a logical distribution of n-layer business processes, in order to ensure the separation between business logic and design logic, in this way each layer interacts with its adjacent layers, Allowing to isolate the functionalities of each one of them and obtain products of the functionalities of the upper and lower layers.

The style established for the architecture is bottom-up, where each element of a Layer i notifies elements of the top layer i + 1 that it has generated some product that is of interest to it. Figure 3 shows the architecture in 6 Layers. Each layer (i) is independent and interacts with the next layer (i + 1) providing elements of its functionality.

**Figure 3.** Personal Information Management Architecture in a Mobile Environment.




**Stage 3. Functionality of Layers and their workflows**

*Description of the functionality of each layer*

Any information system based on architecture, must consider as a precondition the preparation of the information in order to have it in a standard digital format. The following minimum functions are described:

Precondition: Preparation of information

a. Obtaining. Information must be obtained that integrates a person's personal profile (personal data, sensitive data, career path, educational background) available in heterogeneous formats.

b. Check. Review of the information by a trusted entity in order to verify its origin and content.

c. Digitization. The same owner or a qualified entity will proceed to edit information in standard digital format Multipurpose Internet Mail Extensions (MIME).

Given the conditions established in the precondition, the functionality of each layer is described below:

1. Management of personal object.

    d. Reception. Acceptance of the information that integrates the personal profile of a person (personal data, sensitive data, professional career, educational trajectory) in files with standard digital format.

    e. Object Management. The personal object of the owner of the information is created and / or edited.

2. Validation.

    f. Certification of entities. Establishment of a global trust entity that certifies and in turn gives ability to its partial certified entities to validate the information.

    g. Certification of owner. Generation of Digitally signed digital certificate by trust entity and pair of keys (public and private) of authentication for the owner of the personal object.

    h. Digital Signature of Personal Object. Certification of the validity of information by one or more certified trust entities, that is, each document that integrates the personal profile must be digitally signed by one of those entities.

3. Storage.

    i. Management interface. Generation of software interface called Personal Object Manager responsible for the storage and administration thereof as well as Digital Certificate and pair of security keys (public and private) in a mobile device.

    j. Object Repository. Management of a storage unit of all validated personal objects.

4. Comunication.

    k. Distribution. Medium or service to place the personal object available to other systems.

5. Presentation of information.

    l. Format. Presentation of data subject to data format standards.

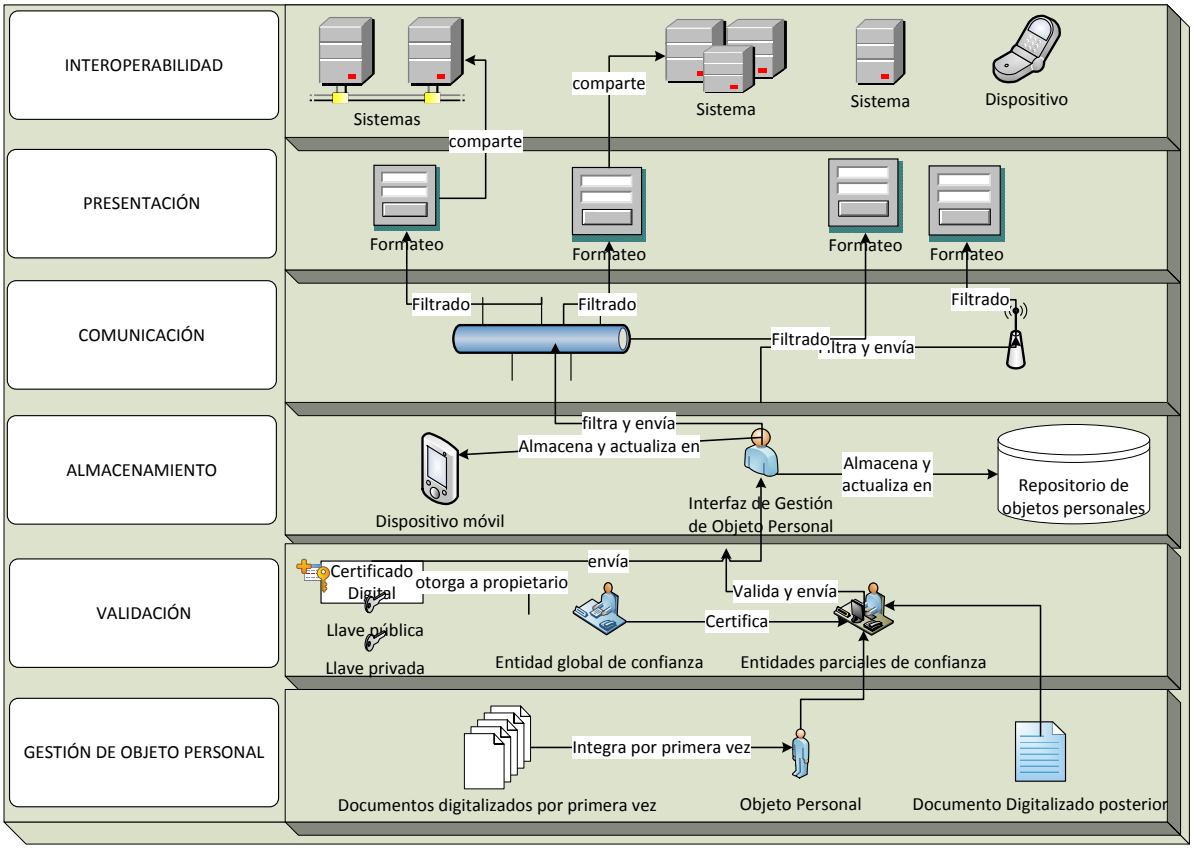
6. Interoperability.

    m. Collaboration with other systems. Provide the ability to share and exchange information with other systems transparently to the owner.

    n. Filtered out. Establishing levels of information sharing according to the owner's preferences, only transfers what the user wants.

The way in which each layer collaborates with the adjacent ones within the model is shown in Figure 4, where each layer contains own processes that generates deliverables for the respective top layer.

**Figure 4.** Functions for each layer of architecture.



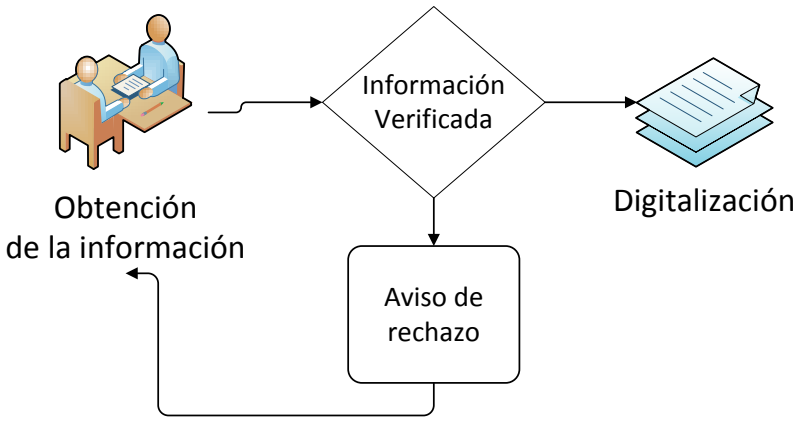

*Workflows for each layer*

Before defining the processes corresponding to the Layers of the architecture, the activities to be carried out as previously established as a precondition (preparation of the information) are explained. This stage is relevant because it provides the first layer of the architecture with the necessary inputs for its subsequent subsequent treatment.

1. Preparation of the information.

In the process of preparing the information, the existence of the entity in charge of verifying information is highlighted. The entity must have adequate tools and support in order to be able to determine the originality of the documents and information. Figure 5 shows the process by which documents are verified, accepted and digitized according to the functionalities described as precondition.

**Figure 5.** Process of preparation of the information (precondition).




Once the appropriate conditions are fulfilled, product of the information preparation stage, we proceed to describe each process corresponding to the layers that make up the architecture.

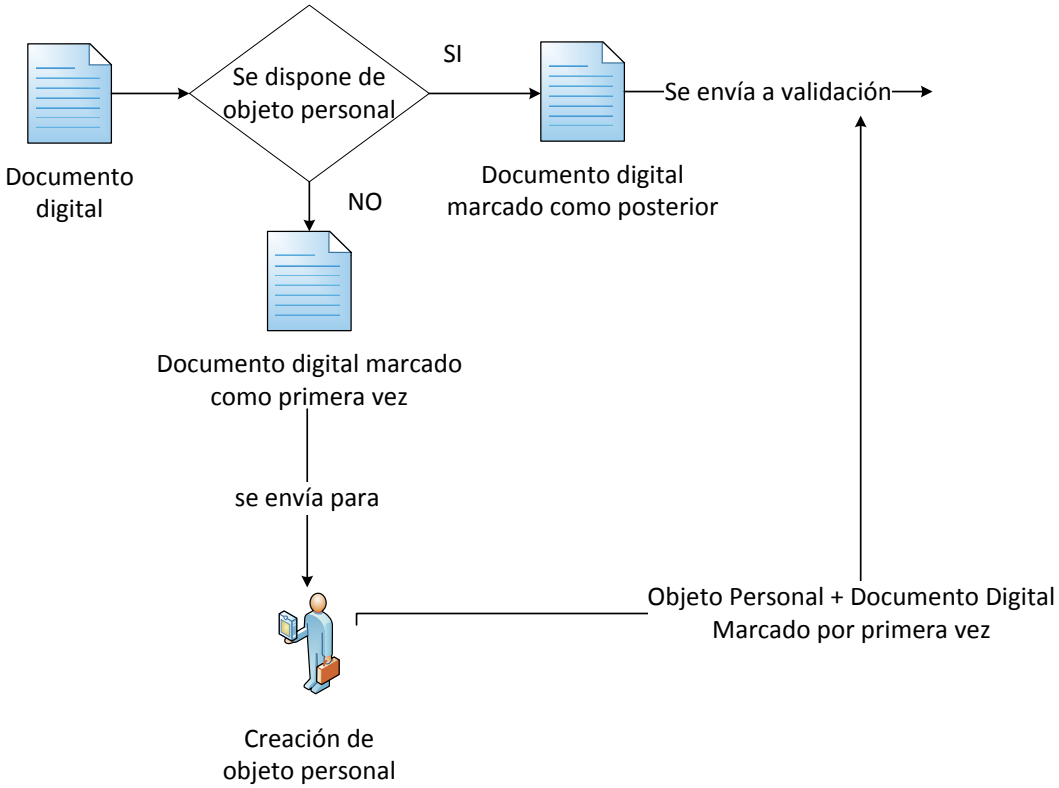
1. Cover 1.

Figure 6 illustrates the process in Layer 1 where once the personal information in digital format is available, one of the following decisions is made:

o. In case the owner does not have a personal object, it is managed for the first time and it is sent to Layer 2 for validation through each corresponding trust entity.

p. Otherwise, that is to say that a personal object is already available, the scanned documents are sent to Layer 2 for validation by each corresponding trust entity.

**Figure 6.** Personal Object Management Process in Layer 1.



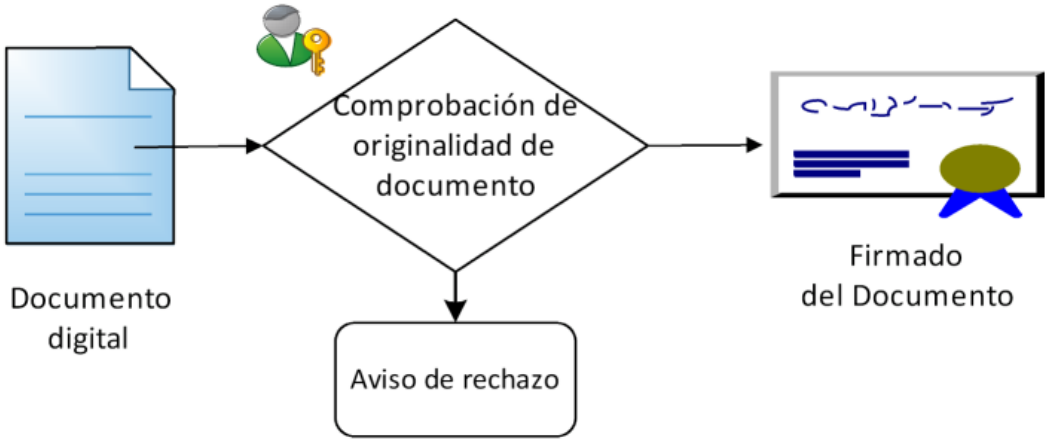

Cover 2.

The architectural scheme must be operating in a trusting environment, so the certification of the documents lies in the establishment of a trustworthy global entity, in charge of certifying all participating entities with the ability to validate information. This entity also grants digital certificates and keys to owners in order to provide them with the ability to manage their own information. Figure 7.

**Figure 7.** Certification Process of entities participating in Layer 2.


In this way, each certifying entity validates the verified information by digitally signing it according to the process in Figure 8.

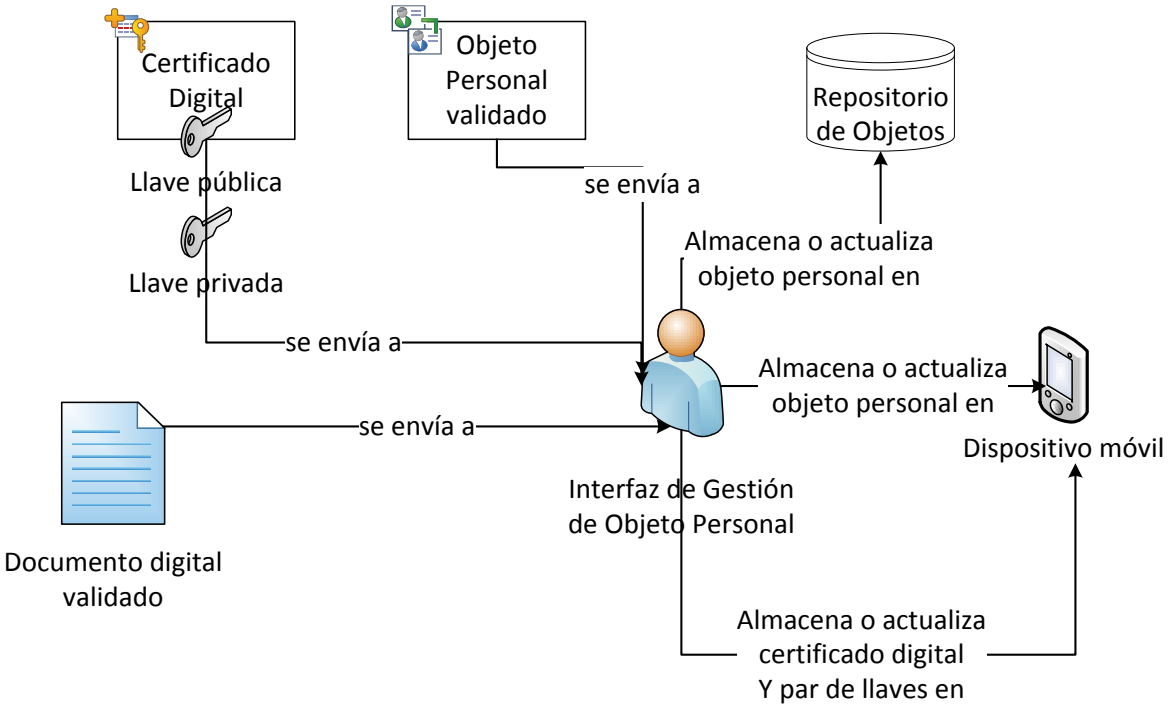
**Figure 8.** Document validation process in Layer 2.



Cover 3.

At this stage an interface is required for the storage, distribution and transport of both the personal object and the digital certificate and owner pair of keys on a mobile device. On the other hand, the personal object management interface must deal with the process necessary to attach the digitally signed documents to the personal object so that it is always up to date. It is also responsible for storing or updating a repository of objects (Figure 9), to remain available to its owner.

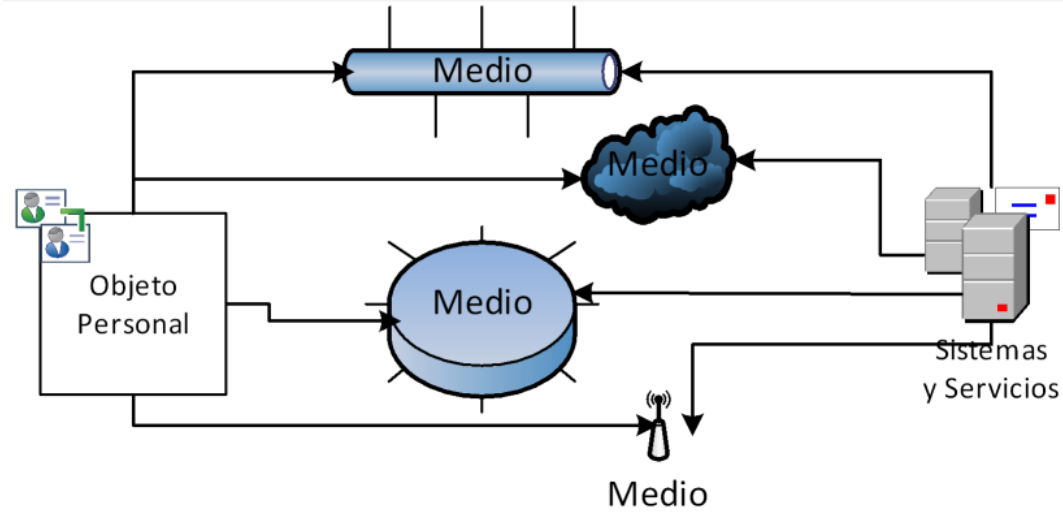
**Figure 9.** Storage and upgrade process in Layer 3.




Cover 4.

The personal object must now be made available to other systems, through any means or service of communication, ensuring their confidentiality, integrity and availability (Figure 10).

**Figure 10.** Availability of the personal object in Layer 4.

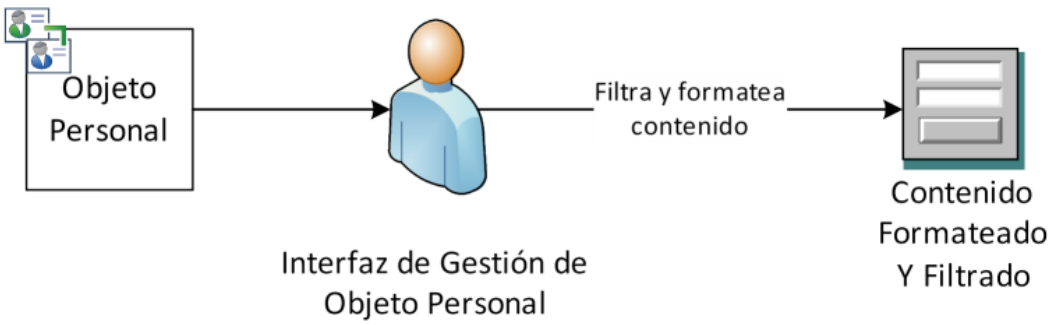



Cover 5.

In order to share the information through the personal object, it is a basic requirement that the documents are in MIME formats under data presentation standards in order to grant adaptability to various information systems.

On the other hand, it should be mentioned that not all content must be available for all systems, but subject to the preferences of the owner, so that he himself must have the ability to select in a convenient way through the implementation of a service Filtered, the information you want to share. The filtered service must not exceed its scope, that is to say, the information of the personal object to which any system or service has access must be solely and exclusively that the owner wishes to provide and there is no means or action that violates this premise As shown in Figure 11.

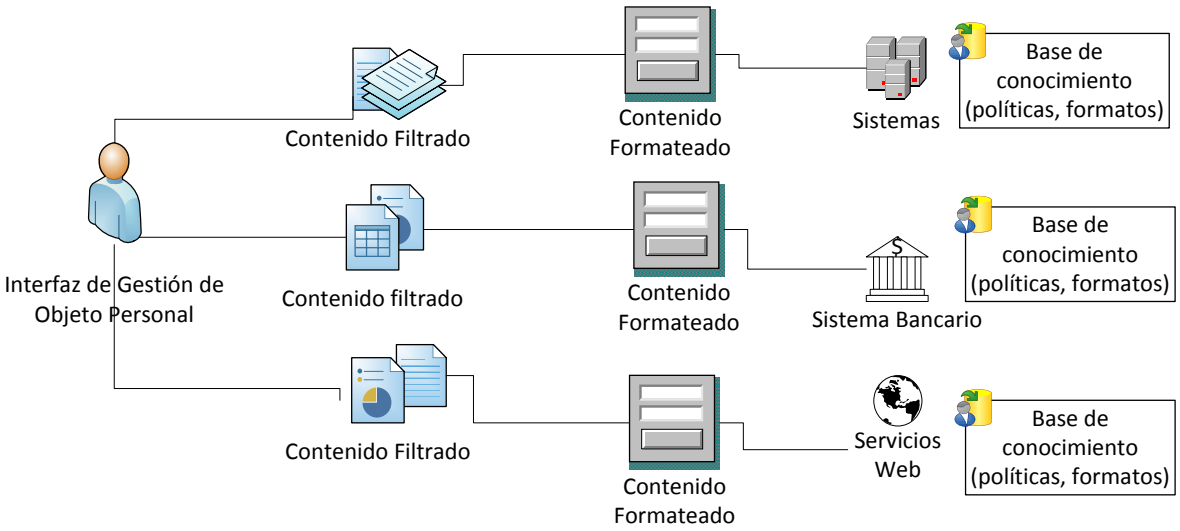
**Figure 11.** Content format of the personal object in Layer 5.




Cover 6.

Interoperability and systems integration are topics of priority need in this architecture, since collaboration with other systems and services will ensure the availability of information. This is the only layer that will have communication with other systems. Figure 12 illustrates the mechanism for information sharing and interoperability with other systems.

Figure 12. Sharing information for integration with other systems Layer 6.



Use Case models were used to represent a view of the architecture, showing the corresponding Personal Object Manager, who is the actor with the greatest interaction in the design (Figure 13).

**Figure 13.** Personal Object Manager Use Case Model.


## Result

The architecture, which described its construction process, is designed under the principles of:

a. Scalability. For its ability to adapt to processes and business logic.

b. Employability. Because of its potential to be applied in various organizations.

c. Interoperability. Thanks to its ability to interact and share information through standardized communication interfaces with other existing systems without any restriction.

d. Portability. Ensuring a zero dependence on the software in which the processes are developed.

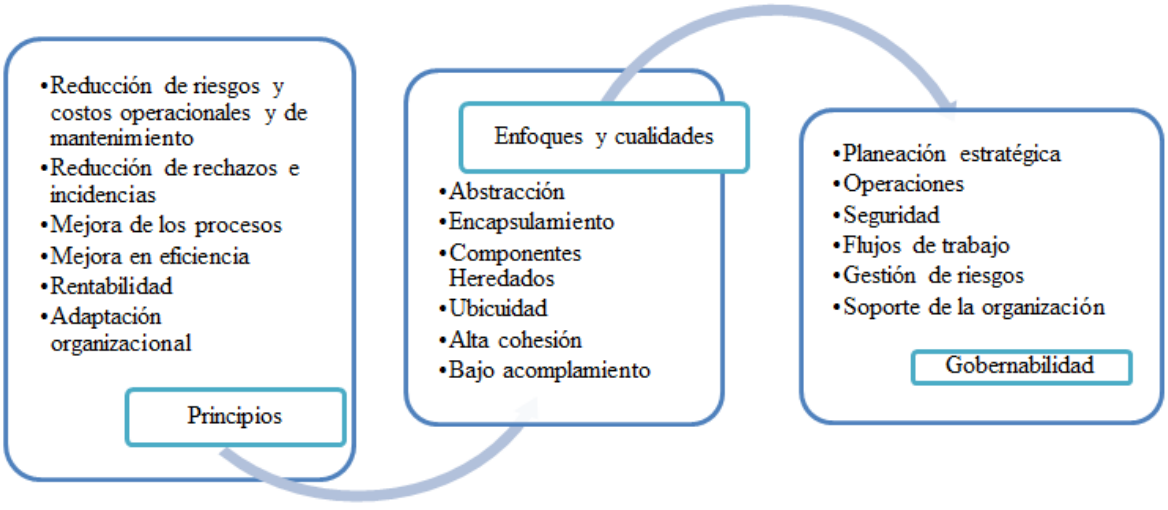
The aforementioned principles endow the architecture with the following characteristics:

a. Being Structured, corresponding to a stratified and modular design.

b. Be flexible in its processes before any organizational situation, based on standards in order to ensure integration with other systems and adaptable to the processes and business logic of organizations.

Within an organizational environment, the architecture defines the structure, organization and relationship between business logic and technology, being constituted by processes represented by models to achieve integration and coordination between systems. It is also composed of a set of reconfigurable modular business processes with high cohesion and descriptions based on protocols and interfaces. It also supports weakly coupled components and services to enable business flexibility in an interoperable and technology-independent manner. It is iterative since a process is composed of more particular ones, for example those that describe technical utilities like security and authentication. Its management elements are classified into 3 main groups shown in Figure 14.

**Figure 14.** Elements of architecture.




In order to provide interoperability between the systems that are implemented in the architecture it is necessary to rely on international open standards of security and data exchange (Cadena, 2010). In the case of Mexico would adopt those listed in the electronic signature (SAT, 2015). Layer 6 was proposed as it allows the interoperability between

developed systems according to the guidelines established by the architecture, thus fulfilling the research hypothesis.

## Conclusions

The great boom that currently have topics such as mobility and ubiquity, as well as the heterogeneity of mobile devices and systems, gives rise to new scenarios that favor cooperation between individuals through the widespread use of all these advances in technology. In this sense, information as a basic element gives added value to these scenarios and implies new needs and requirements for the development of organizational systems, both those already implemented and future ones. From the present work opens a huge possibility of research on mobile computing centralized in information management, to make future systems and schemes particularized on the use of mobile solutions in order to give greater value to organizations.

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