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Interoperability in social security

Technical report

Technical Commission on Information and Communication Technology
International Social Security Association (ISSA)
Geneva

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1. Introduction

Interoperability techniques for the integration of computer and information systems play an increasingly important role in the implementation of social security systems, particularly those which include social programmes or services provided by several different sectors or institutions. Institutions need to use interoperability techniques to integrate the information systems of individual social programmes if they are to put into practice current trends towards the integration of social policies and programmes now appearing in all areas of social security, as well as to construct information services and systems to be shared between the different institutions or bodies which operate social policies. In the same way, applying these interoperability techniques internally within institutions can bring improvements in the quality of their internal management.

This report describes concepts and practices concerning the application of interoperability in social security. It is part of the “Information and Communication and Technology (ICT) as enabler of social security policy and programme integration”, project being carried out by the International Social Security Association’s (ISSA) Technical Commission on Information and Communication Technology during the 2011-2013 triennium. One of the objectives of this project is to look at the complexities of implementation of interoperability when it integrates information and services associated with different social programmes, in order to identify solutions and share experiences. This report is thus part of the documentation which constitutes the ISSA Guidelines on Information Technologies currently being prepared.

The report analyses the scope and implementation of interoperability in the area of competence of social security institutions. It has been divided into a series of chapters to assist in understanding interoperability in its entirety. Chapter 2 provides a series of definitions and basic concepts of interoperability along with a set of principles for application. Chapter 3 describes the dimensions of interoperability from various points of view and defines a series of models for the application of interoperability in the systems involved. Chapter 4 describes various interoperability initiatives in the field of electronic administration in different countries. Chapter 5 describes a number of scenarios for the application of interoperability in the social security sector. Chapter 6 consists of a series of considerations concerning the application of interoperability in social security providing details on aspects to be taken into account in each one of the dimensions of application of interoperability, and presents a model for practical application.

2. General concepts

There are numerous definitions of interoperability but one of those most often quoted, which defines interoperability of information at a high conceptual level, is the one proposed by the Institute of Electrical and Electronics Engineers (IEEE) in 1990: “the ability of two or more systems or components to exchange information and to use the information that has been exchanged”.

The Australian Government, in its Interoperability Technical Framework (ITF, 2003), defines interoperability in the information technology sector as “the ability to transfer and use information in a uniform and efficient manner across multiple organisations and information technology systems. It underpins the level of benefits accruing to enterprises, government and the wider economy through e-commerce”.

Along the same lines, the European Interoperability Framework (EIF, 2004) for Pan-European e-Government Services, a reference document for the development of the common standards and infrastructures required for the implementation of interoperability in the field of European electronic administration published by the European Interoperable Delivery of European e-Government Services to public Administrations, Businesses and Citizens (IDABC) programme, considers that “interoperability is the ability of ICT systems and the business processes they support, to exchange data and to share information and knowledge”.

The CEN-TC251 Committee of the European Committee for Standardization defines interoperability not as a capacity or ability as before, but as “a state that exists between two applications in connection with a specific task, when one application is able to accept data from the other and appropriately and satisfactorily complete a task without requiring external intervention”.

Finally, seen from a purely technical perspective and moving away from these definitions, interoperability refers to the relationship between two or more applications or information and communication technology systems (hardware and communication equipment or software components) which are able to function together easily and automatically. The definitions agree that the systems involved must have two attributes: the ability to communicate between each other (to be able to transfer information) and understanding of the structure of the information which is transferred between the entities (to be able to make use of it). The information which is the object of the transfer may be of any kind: text, video, audio, software applications, crude data, etc., generally speaking resources and the associated meta-information.

All the actors involved including governments, industry, users and consumers, social partners and others, have recognized the need for interoperability and the benefits that its introduction could bring. However, although everyone agrees on the need, scope and implementation of interoperability, on the incentives to push forward and the technical and political barriers which obstruct it, certain controversial issues remain.

One of the principal concerns is the implementation of interoperability and the definition of open standards which make it feasible. The development of standards and their widespread adoption is one of the principal mechanisms or approaches for the introduction of interoperability, providing guidance and advice for those involved in the creation of digital data and services and establishing minimum norms that the systems must respect in order to be able to communicate and exchange information.

The International Conference on Interoperability (CI, 2008) made the following declaration: “In a global society and in the light of the increase in the diversity of systems and applications, interoperability is what makes the development of a mass market possible and avoids the undesirable effects of fragmentation. In this context, standards are a cornerstone to achieve a satisfactory level of interoperability in this global market, which explains the reason why interoperability should be negotiated at the international level.”

This is why main stakeholders in the ICT industry have worked actively through associations and standardization organizations in order to progress towards the development and adoption of open standards. In addition to investing important sums of money in the development of standards and ensuring that the software and hardware that they produce is compatible with them, these stakeholders are cooperating at previously unheard of levels to align their technologies in such a way that they can interoperate, and are making significant progress.

A set of principles has been developed (GIF, 2007) to guide the development of ICTs in administrations and to provide selection criteria for standards to forward their development within an interoperability framework; seven key principles are described below:

- **Interoperability:** Guarantee a coherent medium for communication in order to create a flow of information between individuals, enterprises, governments and their partners. Only those specifications must be selected which are relevant for the interconnectivity of the systems, the integration of data, access services and contents.
- **Scalability:** Ensure easy use, adaptability and ability to respond of the applications when requirements change and demands fluctuate.
- **Reusability:** Establishment of processes and standards for similar procedures to try to develop reusable data services and structures.
- **Openness:** Focus on open standards, i.e. all standards and guidelines must be based on open standard principles. Whenever possible, open standards should be adopted at the same time as the technical specifications are established. Neutral standards independent of the provider and the product should be preferred to proprietary alternatives.
- **Market support:** ICT providers should be selected who base their developments on standards.
- **Security:** Ensure reliable information exchange able to conform to an established security policy.
- **Privacy:** Guarantee data privacy for citizens, enterprises and governmental organizations, respect and enforce respect of the legally defined restrictions concerning access and dissemination of information, and ensure that the services can provide a consistent level of protection for personal data.

Interoperability between administrations implies a list of needs and benefits; it includes the following needs:

- cooperation between administrations involved in the establishment of public services;
- exchange of information between the administrations in order to comply with legal requirements or political agreements;
- sharing and reuse of information both internally and between administrations for increased administrative efficiency and to reduce the administrative costs for citizens and enterprises.

Meeting these needs leads to the following benefits:

- improved public services for citizens and businesses which facilitate the one-stop shop delivery of public services;
- reduction costs for public administrations, businesses and citizens through the efficient and effective provision of public services.

3. Interoperability models and dimensions

3.1. The dimensions of interoperability

Interoperability can be approached from different angles which determine the types, aspects, focus and dimensions of interoperability.

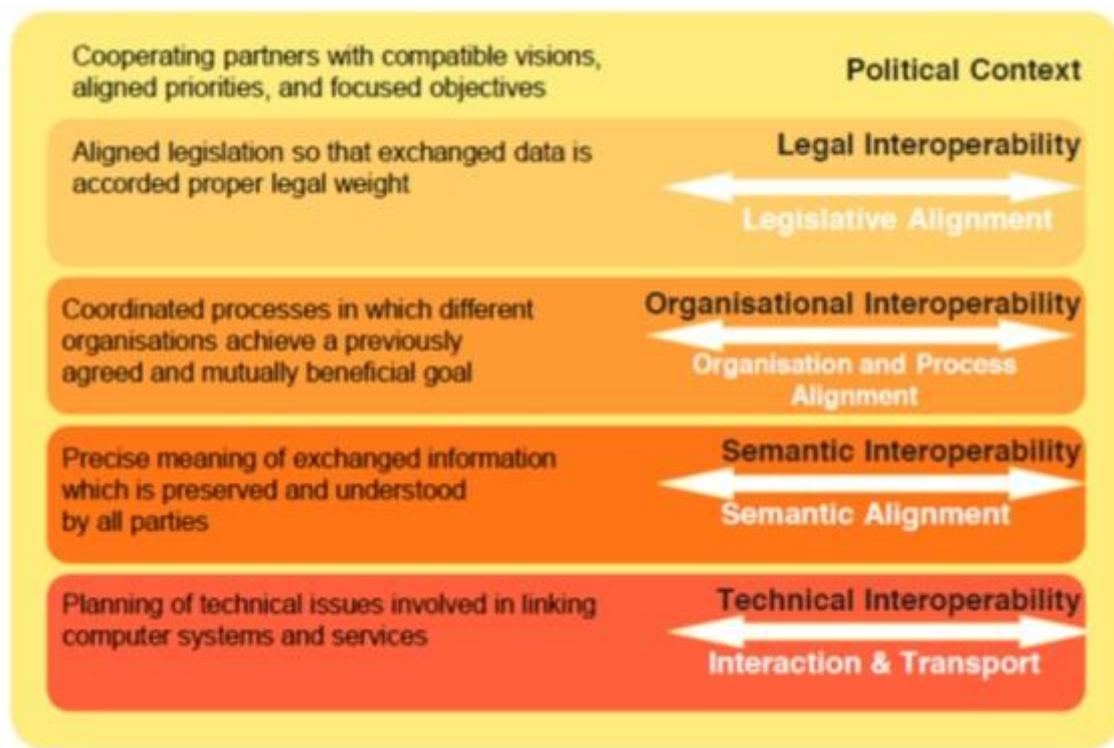
The application of interoperability, particularly in complex organizational contexts, means taking into account the different organizational levels or sectors involved in the interaction. The general concept of interoperability can thus be subdivided into various dimensions.

Interoperability, whether applied to e-government as in defence and strategy systems, or in digital libraries and information services, is characterized by the following dimensions:

- **Political:** Collaborators must have visions which are compatible, priorities which are in line with each other and must focus on the same objectives.
- **Legal:** Adequate synchronization of the legislation in collaborating countries must include the fact that the electronic data generated in one country must be properly recognized when used by the receiving country.
- **Organizational:** This refers to the definition of business objectives based on business procedures and tries to facilitate collaboration between administrations or institutions which wish to exchange information and which may have different structures and internal procedures.
- **Semantic:** Ensures that the precise significance of the information exchanged is comprehensible for any other application not initially developed for this purpose. Semantic interoperability enables systems to combine the information received with information from other sources and to process it in a coherent way.
- **Technical:** Addresses critical aspects of linking computer and service systems. Includes key aspects such as open interfaces, interconnected services, the integration of data and middleware, the presentation and exchange of data, security and the accessibility of services.

In particular, this is the approach of the European Interoperability Solutions for European Public Administrations (ISA) Programme and thus the approach of electronic public administrations. The following diagram, Figure 1, is taken from the reference document European Interoperability Framework v 2.0 (EIF, 2010).

Figure 1. *Interoperability dimensions EIF v2.0*



From the point of view of defence and strategy, Sandor Munk (Munk, 2002) considers that interoperability makes sense in various sectors including physics, computer technology and the cognitive and social spheres. Focusing on interoperability in computer technology, Munk distinguishes a “syntactical level” for the representation of data, including in particular languages, messages and data formats used during information exchange.

The British research organization UKOLN, which focuses in particular on disseminating practical information and influencing policies concerning digital libraries, information systems and the management of Web bibliographies and technologies, takes a wider view of the dimensions of interoperability (technological, semantic, political and human, intercommunity, legal including international) and addresses a number of unavoidable issues related to the exchange of information between systems.

3.1.1. Relations between the different dimensions of interoperability

If we consider the technical, semantic and organizational dimensions as fundamental in any interoperability schema, we find the following relations:

Technical interoperability can be considered as a prerequisite to successful semantic and organizational interoperability. Systems and components must first interconnect physically, at the protocol level, before interoperability at the level of data and semantics can be established.

Semantic interoperability supposes agreement at the technical and organizational levels. Firstly, whatever the chosen medium the issues of technical interoperability must be taken into account, and construction must be based on standards, guidelines and tried solutions. Secondly, since the meaning of the data depends on the aims and context in which it is used,

semantic interoperability measures are closely linked, and also require and imply organizational interoperability measures.

Similarly, organizational interoperability depends on the previous two. On one hand, the technical level must include minimum levels of security in order to be able to initiate interoperability at the organizational level, thus defining policies, strategies and procedures. On the other, joint understanding and adequate processing and exchange of sets of data depends on agreement concerning concepts and their mutual relations. These agreements and the procedures for reaching them can only be addressed at the organizational level.

3.2. Interoperability models

Interoperability is a concept which can be implemented in highly different environments where there are various systems if information needs to be exchanged, and in each one of them a specific interoperability model could be established.

Some environments are characterized by the sphere of application of the interconnected systems: that of information technologies, for instance, which would cover various functional areas depending on the type of use to which they are put (such as electronic administration, electronic business and e-learning); the spheres of interoperability vary for each area of application.

Thus application environments of interoperability may also be differentiated according to the technological sectors to which they belong: the private sector, the public sector, or both. In addition, however, environments are characterized by their political and geographical weight and the quantity of systems and services involved, since interoperability is not applicable only to a specific area or sector, or to the local or national level, but may (and should) have a universal impact.

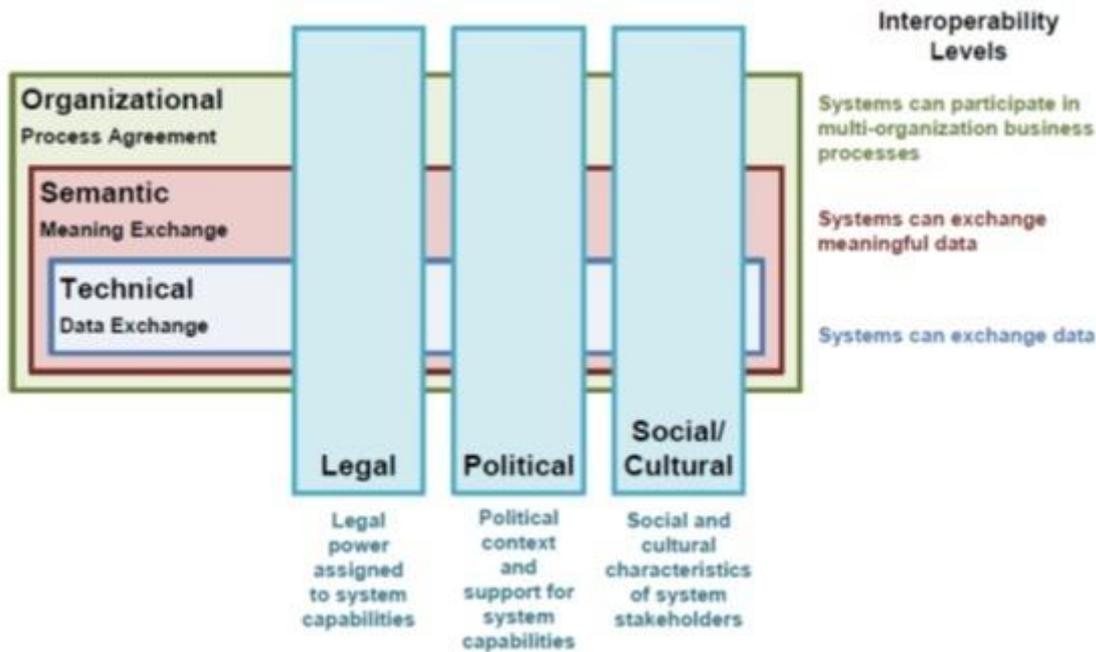
In this context a number of attempts have been made to classify and define the models applicable in the area of interoperability, in order to categorize and also measure the impact of the different environments where interoperability can be established.

The Software Engineering Institute of the Carnegie Mellon University (SEI, 2012) has provided us with an article entitled “Interoperability in the e-Government Context” in which they propose a model to understand interoperability in the area of e-government. The model they propose is based on models such as LISI, OIMM, LCIM, NATO C3, EIF and GIF, which lead them to the conclusion that all of them can be defined in terms of objectives, types and levels of interoperability. The starting point of the model they propose is the definition of the general objectives of interoperability and they go on to locate them in given levels of interoperability and finally add a series of influencing factors.

They propose the following objectives of interoperability:

- **Data exchange:** The first goal with respect to interoperability is basic data exchange, not seen in terms of meaning but simply as the transfer of data.
- **Meaning exchange:** In meaning exchange all participants in a given communication assign the same meaning to the information that is exchanged.
- **Process agreement:** In this objective of interoperability there is agreement on how to act on information that has been exchanged i.e., all participants in a given communication have the same understanding of how to act once they have exchanged information.

Figure 2. *e-Government levels of interoperability*



They propose the following objectives of interoperability (Figure 2):

- **Technical interoperability:** Where the objective is data exchange, the exchange of data lies at the roots of all communications. Some technical interoperability models further divide this level into sub-levels that map specific modes of communication and separate the data from the communication channel. The approach adopted in existing e-government interoperability models is to abstract the details of the communication in favour of a single level, and this is the approach that we have selected.
- **Semantic interoperability:** Related to the objective of semantic exchange and placed close to technical interoperability because information must already have been exchanged.
- **Organizational interoperability:** Related to the objective of process agreement and placed at the highest level because of the need to have attained the other objectives: in this way we establish the communication and the processes to enable the recipient to act as appropriate.

In conclusion, the document describes a series of influencing factors:

- **Legal factors:** One of the primary concerns from a legal standpoint is the assignment of legal weight to the outputs of a given e-government system to enable the system to support or replace existing public services. Identifying legal issues inherent in public services is crucial to enable the services most appropriate for e-government to be identified. Another area where legal concerns are important is in the assignment of responsibility. All electronic administration systems must fully comply with the legislation, rules and regulations. These may include: regulations on administrative law, intellectual property rights, and privacy and data-protection issues.
- **Political factors:** A government administration that has the political will and power to organize, manage and fund an e-government interoperability project will have a much better chance of success. Without this critical factor, it may be difficult to reach the level of cooperation and coordination among government departments participating

in the project that is required to address technical, semantic, and organizational challenges.

- **Socio-cultural factors:** The potential sources of influence in this area vary widely, depending on the context surrounding the application of the project. For example, in some regions it may be necessary to deliver public services through different or customizable channels. The EIF model proposes a "multi-channel approach" to compensate for socioeconomic disparities and multilingualism as a key factor for building interfaces to public services. Designers may develop services that meet the goals of e-government and the needs of the citizens, but if the target users do not find them accessible and usable they will not be able to adopt those services and the latter will not realize their full potential.

4. Examples of interoperability in public administrations and social security

4.1. Interoperability in Public Administration and e-Government

The public sector's interest in interoperability dates back to the eighties (Guijarro, 2007). At first this interest was related to issues concerning proprietary systems. Standardization was a first attempt to solve these problems. Thus, in 1984, the International Organisation for Standardization (ISO) issued the Open Systems Interconnection (OSI) Reference Model and Standards. Up to then, the information stored in networks was usually developed in proprietary systems and interoperability between these systems was non-existent. However, there was a demand for standards in order to facilitate cooperation procedures and applications independent of the platforms.

In 1988 the USA National Institute of Standards and Technology (NIST) approved the "Government Open Systems Interconnection Profile (GOSIP)", based on recognition in both the public and private sectors of the need to develop a common set of protocols based on the OSI standards, referring to the automatic data exchange procedures between government agencies as one of the reasons for establishing these protocols.

The USA Federal Government in fact showed a strong commitment to OSI and GOSIP. GOSIP was used by the federal agencies which were ready to acquire OSI networks. Even the Defence Department (DD) took the initiative in turning to GOSIP for its future network acquisition. In 1987 the DD turned a corner when it changed from the Transmission Control Protocol/Internet Protocol (TIC/IP) to OSI. TCP/IP was the basic Internet protocol. The TCP/IP and OSI standards existed side by side for two years. At the end of these two years, the OSI standards were to be used in acquisitions. A few years later, however, the NIST (1995) approved the GOSIP update entitled "Profiles for Open Systems Internetworking Technologies" (POSIT). In POSIT, the standards were updated and extended for agencies, thus facilitating the acquisition of network products based on open standards. These standards included not only those developed by ISO, but also those of the Internet Engineering Task Force (IETF).

The government departments were to use GOSIP as a purchasing guide to ensure that systems acquired separately were capable of interaction. The UK version of GOSIP focused more on user applications and on providing technical assistance to assist users in the purchasing procedures for write applications.

Another important turning point came when the European Union developed the European Procurement Handbook for Open Systems in 1994. This was based mainly on the English GOSIP specifications with input from France and Germany.

In general terms there were two reasons behind the strong European emphasis on the definition of standard profiles similar to those of GOSIP in the United States. Firstly, it was because one characteristic of the European market was the higher number of computer manufacturers than in North America, which meant more interconnection problems. The other major incentive was the need for interconnection between Member States (Hartmann, 1990).

Similar effects were produced in the processing sector as in the interconnection network when the Institute of Electrical and Electronic Engineers and the ISO approved the Portable Operating System Interface (POSIC) in 1992 and ISO approved the ODP (Open Distributed Processing) reference model in 1996, after a decade of work on standardization.

More recently, the growth of electronic administration (e-government) has once again brought these concerns to the top of the public administration agenda. It can truly be said that the problem is now world-wide. New trends in the provision of public services include the “customer-centric” approach which tries to mask the complexity of the administrative procedures including a high level of interaction between local, regional, national and international administrations. Interoperability is clearly a key aspect in this scenario, one which must be treated as a basic principle in the conception and development of government initiatives.

We would like to refer to some major interoperability initiatives in the field of electronic administration.

- In the United Kingdom, the e-Government Department published a technical guide, the e-Government Interoperability Framework (e-GIF), updated later, in 2005 (e-GIF, 2005). e-GIF provided a set of specifications and policies concerning collaboration between agencies and the provision of services. It covers four areas: interconnection, data integration, access to services and administration of their contents. It includes a catalogue of technical standards which is reviewed and updated every six months (<http://xml.coverpages.org/egif-UK.html>). Various countries have adopted this model, creating catalogues of standards for use in their respective e-government administration systems. These catalogues have enabled them to establish common criteria for the technologies used by different agencies and ministries.
- The French *Agence pour le Développement de l'Administration Électronique* (ADAE) published its first joint interoperability framework (*Le Cadre Commun d'Interopérabilité* (CCI)) in January 2001, and its most recent version (2.1) in September 2003. The CCI includes recommendations to increase coherence among electronic public systems and to facilitate the provision of multi-agency electronic services. The ADAE disappeared in January 2006 with the creation of the “Direction Générale de la Modernisation de l'Etat” under the aegis of the Ministry of Economy, Finance and Industry, which grouped various structures dealing with issues related to state modernization in general and electronic administration in particular.
- In February 2003, the German Government (Co-ordination and Advisory Agency for IT in the Federal Administration (KBSt-)) published its own Standards and Architectures for e-Government Applications (SAGA). An updated version 2.0 was brought out in December 2003. SAGA also provides guidelines for decision-making among e-government teams in the German administration.
- In Denmark, the National ICT Agency published the first version of its interoperability framework (DIF) in 2004; the latest version (1.2.10) was issued in

December 2005. DIF is intended to provide guidance for public agencies in the development of IT projects.

- Within the European Union, the Interoperable Delivery of European e-Government Services to public Administrations, Business and Citizens (IDABC) programme is noteworthy. The IDABC programme published its Architecture Guidelines (v 4.1) on interoperability frameworks in March 1999, as a supporting document for the Decision of the Parliament and Council 1720/1999/EC “Interoperability and Access to Trans-European Networks for the electronic Interchange of Data between Administrations” Version 7.1 was published in September 2004. These guidelines provide concepts and references for optimum interoperability between European institutions and the agencies and governments of the member states. IDABC later published the final version 1.0 of the European Interoperability Framework (EIF, 2004). Version 2 was approved by the European Commission in its communication “Towards interoperability for European public services” dated 16 December 2010 (EIF, 2010).
- In the USA the Federal Chief Information Officers Council (CIOC) published the Federal Enterprise Architecture Framework (FEAF) in September 1999. In order to increase the influence of the FEAF guidelines on e-government applications, the CIOC included it in July 2002 in the guidelines on Federal Government Projects.
- In Spain, a National Interoperability System (ENI) (ENI, 2007) is under development. Its aim is to include all the criteria and recommendations concerning the security, storage and standardization of data, and the formats and applications that should be taken into account by the public administrations in taking the technological decisions which guarantee interoperability.

Its field of application is laid down in Article 42 of the 2007 legislation on e-government concerning electronic access to public services for citizens.

The aim of the National Interoperability System is to create the conditions required to guarantee an appropriate level of technical, semantic and organizational interoperability in the systems and applications used by the public administrations to enable proper exercise of rights and fulfilment of obligations through electronic access to public services, at the same time improving both their efficiency and their effectiveness.

In order to create these conditions, the National Interoperability System has introduced common factors intended to help public administrations get up to date in the interoperability sector. In particular, it introduces the following main elements:

- It lists the special principles of interoperability.
- It discusses the dimensions of organizational, semantic and technical interoperability as laid down in Article 41 of the 2007 Law on e-Government.
- It describes the joint infrastructures and services, factors known to affect the dynamics, simplification and propagation of interoperability while at the same time facilitating multilateral relations.
- It addresses the reusability of public administration applications, related documentation and other sources of information; given that the word “sharing” is present in the definition of interoperability included in the 2007 Law on e-Government alongside the word “reuse”, both are relevant to interoperability and embodied in European Union policies in connection with the idea of sharing, reusing and collaborating.
- It considers interoperability in relation to electronic signatures and certification.
- It deals with the recuperation and preservation of electronic archives as laid down in the above-mentioned 2007 Act on electronic administration, as an aspect of

interoperability in the long term, and one which has an enormous effect on electronic documents.

- Finally, it provides technical standards for interoperability and interoperability tools to facilitate the implementation of the Schema.

It takes into account the recommendations of the European Union and the technological status of the different public administrations as well as existing electronic services and the use of open standards alongside, where appropriate and in a complementary manner, the standards in general use among the population.

Reference material on the development of e-government and interoperability in particular in the area of the European Union, on similar approaches in other countries, and on national and international standardization were all taken into account in its development; it also covers the legislation on e-government, the protection of personal data, electronic signatures and Electronic National Identity Cards, among others.

The production process was coordinated by the “Ministerio de la Presidencia” (Presidential Ministry) with the participation of all the public administrations. All the public administrations took part in the drafting process. Over the past three years, more than one hundred experts from the public administration have collaborated in its preparation; many others have also contributed through professional ICT associations and everything was carried out in the light of the most recent developments based on the most widely recognised references in the field of interoperability:

The United Nations Development Programme, (UNDP) has published various documents outlining GIF, which focus in particular on its technical aspects.

- In New Zealand, the New Zealand E-Government Interoperability Framework (NZ e-GIF, 2008) provides a set of policies, technical standards and guidelines. It covers the various ways of achieving interoperability of data and information resources in the public sector, information and communication technologies and electronic procedures. It enables any agency to combine or share its computer resources with those of any other agency using a predetermined framework based on international open standards.
- Hong Kong also has an interoperability framework which defines a set of specifications designed to facilitate interoperability between systems and provide terms of reference for the development of projects in the e-government sector. The technical specifications are reviewed every six or twelve months.
- In Latin America, the document entitled “Bases para una Estrategia Iberoamericana de Interoperabilidad” (Foundations for a Latin American Interoperability Strategy) presented at the XII Conferencia Iberoamericana de Ministros de Administración Pública y Reforma del Estado, deserves a special mention. The IX Conference adopted the “Carta Iberoamericana de Gobierno Electrónico (CIGE)” (the Latin American Charter on e-Government). This represented a turning point in the construction of a regional approach to the development of e-government, and referred explicitly to interoperability as one of the key factors to be taken into consideration.

Many countries have developed interoperability frameworks, “white papers” have been produced by regional experts, the technology industry has helped various governments to move forward, there are a certain number of on-going international projects which address this issue and academia is beginning to produce a few reports on the subject. However, while praiseworthy individually these efforts are unconnected and thus paradoxically ignore some of the basic tenets of interoperability.

This is not true of interoperability between the administrations of different countries. The closest collaboration is that of the “Acuerdo Complementario al Acuerdo de Cooperación Técnica” (The supplementary agreement to the Technical Cooperation Agreement) between the Governments of the Republic of Argentina and the Federal Republic of Brazil for the implementation of the “Interoperabilidad de Gobierno Electrónico” (e-Government Interoperability) project approved by both states in February 2008, and the “Convenio de Colaboración para la Prestación de Servicios de Validación de los Certificados Electrónicos de España y Portugal” (Collaboration agreement concerning the validation of e-certificates in Spain and Portugal) signed in September 2009.

The former document lays the foundation for a Latin American Interoperability Strategy. It defines basic elements to facilitate the use of information and communication technologies by governments and public administrations in the region to improve their coverage, offer new public services and reinforce the administrative procedures involved in the implementation of public policies affecting two or more states.

Finally, the United States and Canada have taken various interoperability initiatives in the sphere of e-government in support of business architecture frameworks such as the Zachman Framework [Zachman, 2008] and the Open Group Architecture Framework [TOGAF, 2008]. The USA government also offers a series of guidelines on architectural frameworks currently in use in these projects [OMB, 2011].

4.2 Interoperability in social security

Interoperability techniques have been applied in various social security contexts which can be grouped into categories as follows:

- social protection programmes and social services;
- global health insurance systems;
- collection of social security contributions and control of obligations;
- improvements in institutional efficiency and in the quality of the information and services provided;
- international social security agreements.

We must emphasize that these categories are not exclusive, and that there are cases which could be included in more than one of them.

4.2.1 Social protection programmes and social services

The aim of both social protection programmes and social protection networks is to provide economic benefits to those who do not contribute to the system, mainly the most poorest. CEPAL, for instance, covers “the mechanisms for the design and execution of various social programmes coordinated by traditional social security methods, the provision of social services and the supply of welfare programmes”.

Although the characteristics of the social welfare programmes vary, they have certain elements in common (BID, 2011):

- they focus on the poorest among the population, the least protected, the most vulnerable and critically poor;
- they cover a wide range of initiatives including cash transfers, food provision, access to basic health care, education, accommodation etc.

- activities tend to be organized in the form of global social networks or programmes, so that activities do not consist of isolated actions, but form part of a set of policies and strategies for the provision of social protection;
- the social welfare programmes define incentives, requirements, conditions and considerations concerning beneficiaries, who must assume a share of their obligations in line with the concept of conditional transfer programmes;
- initiatives involve the participation of beneficiaries and many of them include social control mechanisms.

The introduction of social welfare systems or networks with these characteristics relies on integrated information and services, frequently involving a number of institutions. Such systems have been introduced in Argentina, Brazil, Chile, Colombia, Mexico and Uruguay (BID, 2011) (ILO, 2011), among others.

However, social service programmes widespread in the developed countries provide different types of benefits for the population as a whole, which results in major differences between them and the social welfare programmes previously described. The need to use integrated data on beneficiaries has also been recognized in this context, in order to improve the quality of the services, particularly in terms of the allocation of benefits (also known as “Case Management”). The situation described by (Carter, 2009) in particular, shows the tragic consequences of the lack of coordination between social programmes in the District of Columbia in the United States. These problems have been addressed, for example, by the social services of New York City and a group of counties in the State of California. Both projects involved the introduction of global information systems with data culled from different types of benefits providing support for the analysis of eligibility and the allocation of benefits. France has created the Joint National Social Protection Register (*Répertoire National Commun de la Protection Sociale* (RNCPS)) (RNCPS, 2006) in order to improve the quality of the services provided and to detect fraud. This system registers data concerning the identity of beneficiaries, the organism to which they belong, risks covered, and other information included in the forms submitted when applying for benefits.

To sum up, the most conspicuous characteristics of this type of scenario are the creation of information systems concerning individuals (potential beneficiaries), based on data from various institutions or social programmes. These systems are used both to identify beneficiaries and to help classify cases as well as to monitor the programmes and analyse their impact. In the examples described, interoperability was based on:

- the introduction of shared information resources, particularly concerning beneficiaries and the social programmes to which they were entitled;
- access to data from external institutions (e.g. through the use of Web services) to collect data for the shared information system;
- access to their own shared information systems via programme mechanisms (e.g. Web services).

4.2.2. Global health insurance systems

One of the most widespread models is that of health insurance systems as providers of public and private services. Global health insurance systems have been introduced in various countries as a means of improving the coverage and sustainability of the system as well as the quality and efficiency of the public services; they integrate the various insurance sectors to a greater or lesser extent and provide links between them and with medical service providers.

Basically, global health insurance systems need standardized information concerning the individuals insured in order to enable the establishments providing health services to check

the rights of those who apply for them. This requires integrated data sources containing information which indicates the status of individual rights to health services, and also the existence of mechanisms to allow those providing the medical services in question to access this information. This type of system has been implemented in Chile, Colombia, Thailand and Uruguay, among others.

In short, although there are differences between the systems implemented in each country, they have the following characteristics in common:

- the systems are based on reference data bases concerning the individuals covered by the health insurance and their rights, which may depend on a variety of situations (worker, child, spouse, etc.);
- different systems are integrated to obtain information which enables these rights to be defined (e.g. other health insurance, systems for the collection of contributions, etc.);
- the aim is to implement a flexible system for the exchange of data among the institutions which provide health services, as well as among policy-making bodies and those responsible for monitoring (e.g. Ministry of Health).

In this type of scenario, the interoperability techniques implemented must:

- implement shared information resources, particularly concerning beneficiaries and the health benefits to which they are entitled;
- introduce programme mechanisms which provide access to the shared information system (e.g. Web services) particularly for health service institutions which may be privately run;
- facilitate integration with other systems managing health insurance data, in particular the work status of contributors to the insurance and their family ties.

4.2.3. Collection of social security contributions and control of obligations

One or more of the institutions responsible for the administration of the social security programmes is usually responsible for collecting contributions and ensuring that obligations are fulfilled, as well as for collecting the information required for allocation of the appropriate entitlements. In order to generate economies of scale, the institutions, both public and private, usually interact with employers who withhold workers' contributions and transfer the total sum, along with the information required for allocation of the entitlements of those concerned.

In this context, the aims of integration between all the actors involved are to increase the efficiency and effectiveness of the system as a whole, as well as to facilitate the inclusion of new contributors and also to monitor the correct fulfilment of obligations.

The most frequent forms of integration are based on the exchange of data:

- between institutions responsible for collection and contributors, in particular with employers who cumulate their workers' contributions of in order to transfer them together;
- between various institutions collecting contributions, including the offices dealing with general taxes;
- with banks and other financial bodies in order to facilitate the payment of contributions.

Integrated systems for the collection of contributions have also been set up to collect contributions for different institutions, social security and also to deal with taxation, although

the full responsibility for collecting contributions does not lie with just one institution (see the examples of Korea, France and Uruguay).

The principal characteristics of this type of scenario are:

- the exchange of data between the collection institution and employers;
- exchange of data, use of shared data and integration of functions with other social security institutions, as well as with institutions responsible for tax collection;
- exchange of data and access to the services of banking institutions providing payment facilities. The interoperability techniques most often used are shared information systems, data exchange and access to external services.

4.2.4. Improvements in institutional efficiency and in the quality of the information and services provided

The integration of information and services can lead to significant improvements in management as well as more effective use of complementary functions provided by different institutions and departments. This type of integration has been put in practice within institutions, through the implementation of single computer systems for centralized (or single entry) data as well as through the implementation of computer systems based on service-oriented architectures (SOA).

Standardized or single-entry information systems within institutions enable them to avoid inconsistencies arising out of multiple data entries and to reduce the cost of collecting data. This also permits the implementation of agile communications when changing data, for example concerning personal, family and employment status. This type of information system has been implemented in numerous institutions.

As yet, only a small number of institutions have chosen to implement systems based on Service-Oriented Architecture (e.g. Norway, the United Kingdom and the State of Vermont, USA).

However, certain countries have implemented interoperability frameworks and platforms specially designed for social security, which enable different institutions to interconnect. The Social Security Crossroads Bank of Belgium which plays the part of an “Integrator” for the Belgian Social Security provides an outstanding example, as does the social security interoperability standard (INTEROPS) (ISSA GP) in France.

To sum up, the aim of these initiatives has been to improve the effectiveness and efficiency of the computer platforms used by social security institutions by systematizing the reuse of services and information, and also to facilitate the agile implementation of new programmes and services for the public. In terms of interoperability techniques, the application of standards such as XML, SOAP, SAML, the use of Web services for systems integration and the application of Service-Oriented Architecture (SOA) to provide a general framework, seems to be the general rule.

4.2.5. International social security agreements

The objectives of international social security agreements are usually: (i) to permit the cumulation of periods of activity carried out in different countries in order to meet the requirements for allocation of a pension; (ii) to create the necessary conditions for “temporarily relocated” workers to retain their cover under their usual social security system and thus avoid having to contribute to a scheme in the host country; and (iii) to facilitate the

administration and payment of benefits regardless of the country of residence of the beneficiary.

The implementation of these agreements is based on the exchange of data between the signatory institutions (e.g. information concerning periods worked in a country, the dates of a temporary relocation, etc.) and corresponds to a certain extent with operations in an international social security system covered by a signed agreement.

In the case of the European Economic Area (European Union plus Norway, Iceland, Lichtenstein and Switzerland) the agreement consists in practice of the application of common legislation (Regulations of the European Parliament and Council). The Regulation in question governs the use of electronic media for the exchange of social security data, which led to the project Electronic Exchange of Social Security Information (EESSI). It is noteworthy that the project establishes common technical architecture which provides public access to an institutional data base, the exchange of information via structured electronic documents and a secure communication protocol.

The MERCOSUR multilateral agreement (Argentina, Brazil, Paraguay y Uruguay) is based on the SIACI system (“Sistema de Acuerdos Internacionales” (International Agreements System)) [ISSA GP]. This system implements part of the pension application procedures, enabling individuals to begin these formalities in their country of residence and enter into communication (electronically) with the social security institutions in the countries where they have worked in order to obtain the information required to complete the procedure. The SIACI architecture represents a “federated” model for the institutions taking part, based on their information systems, which structures the exchange only of data that is strictly necessary.

The systems implemented by the Social Security Crossroads Bank of Belgium and by Centrelink in Australia, stand out among those based on bilateral agreements. Both institutions have developed mechanisms based on the exchange of data in order to implement their different agreements.

To sum up the situation, the implementation of international agreements is based mainly on mechanisms for the exchange of data, which must be validated with an electronic signature. This requires the management of an operations registry for transparency and to enable follow up of the transactions carried out. The interoperability technologies required are mainly standardized formats for dates (XML) and interconnected systems (Web services) of a kind that enable electronic signatures to be included as well as the encryption of dates (WS-Security).

5. Considerations concerning interoperability for social security

This chapter explains how social security institutions should plan each one of the interoperability dimensions, defining a series of issues which need to be taken into account in order to achieve interoperability and including a generic interoperability model for practical application.

5.1. The political and legal dimensions

The implementation of interoperability requires strong political support in favour of cooperation, and the generation of compatible institutional approaches focusing on similar objectives in terms of the implementation of social security programmes. In practical terms,

this involves lining up policy approaches and priorities, top level support for the application of standardized information and technologies and the transmission of instructions to the Administrations concerning the coordination of plans and projects to ensure that the interoperability-based applications are feasible both within the institution and with other institutions.

Inter-institutional interoperability requires not only agreement between the institutions involved, but also political alignment at government level, to promote the joint implementation and coordination of social programmes, taking into account the institutional competencies of the individual institutions and making full use of their operational capacities. International interoperability requires the implementation of international social security agreements as well as parliamentary approval in the countries involved in the agreements and implementation of the necessary “administrative regulations”.

Given that the political context within administrations is constantly changing, mechanisms must be defined to ensure the stability of policies which require medium and long term planning in order to avoid divergence in their approach to interoperability and insufficient support.

Legal interoperability must be used wherever possible to give formal structure to the political approaches which affect the application of interoperability in the implementation of social security systems. This implies adequate synchronisation of the standards on which cooperation is based to ensure that the jurisdictions, competencies and responsibilities of the organisms participating in projects involving interoperability are clearly defined, and that the electronic data from any one of them is given its proper legal weight and recognition. The form that this legislation takes will correspond to different organs depending on the field of application of the interoperability. Regulations on interoperability within an institution should be approved by the highest authorities, in order to ensure that they have maximum political and institutional support. The management of the institutions involved must participate in the case of inter-institutional interoperability, eventually alongside national authorities or international organisations to provide a more general framework (e.g. contracts and agreements signed by the parties concerned).

Ideally, since legal interoperability is driven by objectives decided at the highest political level, the political agreements should lead to a common legislative or statutory framework which covers given areas of interoperability between the organisations involved.

Currently, one of the basic legal issues is the introduction of standards for the protection of data and in particular for administrative data processed by other institutions. Their implementation should lead to the nomination of one or more authorities responsible for that protection as well as the establishment of the necessary collaborative structures and associated mechanisms.

There are many challenges at the legal level. Interoperability may be affected by differences in legislation in areas such as administrative law, identification and authentication, the protection of intellectual property rights, responsibility, data privacy, the transparency of public relations between the administration and public administrations, citizens, businesses and other actors and the reuse of public sector information in the basic registers. Because of this the institutions must be conscious of the impact of proposals for legislative measures concerning the ICT applications and try to harmonize and align their legislation with that of the other administrations with which they wish to collaborate.

One aspect of help to achieve legal interoperability is the use of open specifications and standards in directives concerning collaboration.

5.2. Organizational dimension

Organizational interoperability refers to the definition of compatible administrative and procedural models, in order to create collaboration between the parties who propose to exchange or share information and services, regardless of their internal organization and structure. “Aspects of organizational interoperability” is understood to mean those elements that make it possible to know and understand policies concerning access to data and/or services and their use, personal and institutional responsibilities, and the objectives and aims pursued by the organization in creating data or providing a service. A further objective of organizational interoperability is to meet the needs of the user community in providing services which are available, easy to locate, are accessible and user-centred.

In the context of social security systems, the procedures which could potentially be involved are as follows: administration of common data (e.g. on individuals and businesses), interaction with beneficiaries and/or contributors (enterprises and workers), calculation of benefits and/or contributions, validation of conditions concerning eligibility for the allocation of benefits or the calculation of contributions, issue of various records, register of businesses and their staff members, etc. The notification of changes of status and events in general concerning individuals and entities which interact with the social security systems should also be considered as suitable processes for interoperability, since such changes in status may have repercussions on various services (e.g. marriages, deaths, illness, unemployment, etc.). As indicated in EIF v2.0 [EIF, 2010], organizational interoperability depends on a wide range of interacting elements, including business processes, business interfaces such as electronic mail, Web portals etc. and business events within and between the administration involving third parties: businesses and citizens. From here onwards, in referring to the administration of citizens and businesses, “life events” will be used for citizens (marriage, for example) and “business episodes” (for example the creation of an enterprise) for enterprises. In this way, citizens and enterprises can focus on their needs instead of on concrete organizations in the public sector. Services provided are centred on the client, transparent and follow a one-stop shop approach. This aspect of interoperability refers to how different organizations such as the administrations of Member States of the European Union collaborate for their mutual benefit and reach agreement on services related to the objectives of e-government.

There is a group of models which can help to analyse aspects of organizational interoperability and measure its level of maturity; the most important of them are Levels of Information System Interoperability (LISI) (LISI, 1998), The Organizational Interoperability Maturity Model [OIMM, 1999] and Layers of Coalition Interoperability (LCI) (LCI, 2003). Detailed information on these can be found in Annex 1.

In practice, organizational interoperability implies the coordination of business processes and the exchange of information between institutions and their departments. In order to be successful, the participants must agree on the content and timing of access to shared services and the exchange of information, on joint regulations to ensure that interoperations are carried out in security, with minimum overload and in a continuous manner. The same standards must also be used to describe the business processes, which must be adequately documented. It would be useful to create a repository for business processes and best practices between those participating, to facilitate their reuse. The use of instruments such as SLA (service-level agreements) to formally recognize specific aspects of mutual assistance and “Memoranda of Understanding” (MoU's) between institutions or countries detailing bilateral agreements on joint actions and cooperation is also recommended.

At a more sophisticated level, efforts must be made to analyse equivalent current business processes in use in administrations in order to establish a common understanding of the business processes (a taxonomy of business processes), to identify common factors, and break down these processes into separate components in such a way as to permit interconnection.

Where different countries are involved, each party is responsible for organizing its trading system based on its own needs. It would not be realistic to think that administrations in different countries have the capacity to organise their business processes according to international requirements. Their own processes can in fact be maintained intact through the use of entry and exit points which ensure that the procedures are transparent for the purposes of interoperability. The key to organizational interoperability is therefore to identify and document which administrations in the different countries are capable of interoperating at the international level for a given e-government service.

The situation may be similar at the internal level. In short, we have to try to establish:

- the services which need to be set up;
- the business processes involved;
- the administrations which are able to provide the necessary business interfaces in order to connect those processes.

In addition, administrations must agree to provide an acceptable level of quality and security, which means that they will have to establish the necessary SLA or other similar agreements.

5.2.1. Lead administrations

From an organizational point of view, when information is exchanged between social security institutions in different countries, the object of the business is to guarantee citizen's rights in the domain of social security, and to ensure that their rights are not reduced because they have moved beyond the borders of their country of nationality. The situation is slightly different in the case of exchanges between member states of a supranational body (such as the European Union) and in the case of bilateral agreements, but they have an underlying problem in common, which is that of a different organization at the two extremes of the exchange. Depending on the way in which each social security administration is organized, the information systems adopt the architectures they need for their own purposes. As a result, exchanges are carried out between systems which are not analogous, which necessitates certain "alterations" in terms of their organizational models. Unemployment in Spain is a case in point: While most countries consider it as a sector within social security Spain takes a different view, and has structured it as a totally independent organization both from the conceptual and physical viewpoint (communication networks, information systems, etc.). The organization of health care is another similar example. The structures will be totally different depending on whether the national system is based on a national contributory model, a residential model or one involving numerous funds. In the case of the latter, the situation will require coordinating bodies (from an organizational not a technical point of view). Coordinating bodies have to collect information in heterogeneous formats, unmonitored and over which they have no decision-making power.

In order to resolve these problems they may use a "Lead Administration" responsible for centralizing both the basic information concerning all the institutions called upon to intervene in the exchanges, in the information concerning the business processes in which each one of the institutions may and must intervene, and in the information flows involved in each electronic document for processing by the appropriate body.

The EESSI (Electronic Exchange of Social Security Information) [EESSI] project which will implement the European Regulation on the exchange of social security data (see paragraph 4.2:5.) is an example of a lead administration which is worth mentioning.

5.3. Semantic dimension

The fact that the information generated by a computer must be processed by another system which must interpret its meaning correctly, leads to a series of additional complications which affect both the source of the information and its recipient, and constitutes the central theme of semantic interoperability. Achieving it requires agreement, for example, on the way in which information is represented and its context. This is what will enable automatic tools to share and process the information, even when it has been registered independently. The objective of semantic interoperability is not only to enable the interconnection of information resources, but also to enable them to be understood automatically and as a result to be reused by computer applications not involved in their creation.

In the context of social security systems, semantic interoperability is fundamental in the development of joint definitions and interpretations concerning the data which is to be processed by various organisms. Social security operations involve a wide range of concepts which in spite of having the same name, may be interpreted differently (e.g. family group, members of the same household, unemployed person, old age pension, health benefits, social security contributions, etc.). Thus, in order to improve understanding of the concepts it is useful to be able to represent the relations between them, principally those of “sub-groups” (e.g. rural workers are a sub- group of workers, etc.).

The resolution of semantic interoperability issues is an activity which must be carried out at sectoral level, taking into account the “life events” or “business episodes” affected in each case. However, it is more likely that a group of data, such as national identifiers for businesses, citizens and administrations, need to be identified at the national or international level (depending on the type of interoperability). This will require the preparation of organizational and technical infrastructures.

For each service requiring interoperability the following will be required:

- the responsible administration will need to provide information concerning the elements of data involved;
- the responsible administration will need to propose an agreement concerning the data and data registers required for the level of exchange, pan European for example;
- the responsible administration will have to prepare a proposal for a multilateral agreement, including tables for the various levels.

An essential requirement for information exchange is a single language to describe the meaning and structure of the subjacent data, for example a mark-up language. In the current technological and market environment, this language is XML. However, XML alone cannot guarantee or provide semantic interoperability. It requires joint semantic development initiatives based on XML. The subsequent introduction of XML schemas and related artefacts (metadata, anthologies, etc.) enables the integration of services developed using different vocabularies and with different perspectives on data.

Special attention must be paid to the language issue when considering the use of vocabulary. In the European Union, the existence of joint legislation (regulations and directives) implies the existence of equivalent terms as part of the legal process. However, this vocabulary must also be used at the national level and this in turn means an effort of harmonization.

Annex II describes the most important technologies for the achievement of semantic interoperability in detail, starting with the general concepts which define Web semantics and then providing more details on the RDF and OWL standards.

5.3.1. Metadata

The achievement of semantic interoperability is seen as one of the most important challenges in the integration of information systems. Basically, this is because of the fact that meaning may change in each context and over time and that different requirements in different domains may lead to different information models. Technical interoperability is close to success thanks to open standards, but achieving semantic interoperability (and that of organizational interoperability) is more problematic since it has an impact on many different levels, functions and processes in information systems.

Semantic interoperability must be taken into account in two communication contexts: man-machine, and machine-machine. The second context covers various dimensions in which information systems may present: structural incompatibilities and incompatible representations in the modelling of concepts, linguistic incompatibilities such as the use of the same term to designate a different concept or the use of different terms for the same concept, as well as conceptual incompatibilities where different information systems use concepts with fuzzy meanings.

One way of achieving semantic interoperability is to use a joint conceptual model (metadata schema) which includes a description of the information to be exchanged in terms of concepts, their properties and the relations between the concepts. The properties of a concept may thus have various values that need joint agreement, and in order to ensure the correct interpretation of the data exchanged between the systems, controlled vocabulary must be used. However, the use of controlled vocabulary is insufficient in order to ensure the comprehension of information which is exchanged in a more dynamic form, and more semantically rich models of knowledge are required, such as taxonomies and anthologies, which define the concepts of a given domain as well as their relationships.

In this sense, metadata schemas can be of fundamental importance in achieving semantic interoperability, together with vocabulary, taxonomies and anthologies. Metadata are sets of basic data for the development of e-government applications and systems. Metadata can be defined just once and then shared and reused on multiple occasions. This reuse brings the following benefits:

- increases interoperability between different systems which share data and services;
- reduce the development cost of interoperable systems, since it avoids processing ambiguities within the applications;
- facilitates the processing of data in information systems in general and in those which integrate and share data in particular, for example systems which provide support for decision-making.

If agreement can be reached on the establishment of metadata between social security institutions, this would enable the creation of interoperable public services. The next step is to identify the metadata used by the different institutions and document it so that it can be pooled. This would enable the creation of a Metadata Management System for the joint use of all the institutions.

In order to help to identify and improve the management of metadata, a schema is given below with five levels of maturity based on (Metadata, 2011):

Level 1 – Metadata Ignorance: Metadata is not documented, perhaps because administrators are not aware of its importance. This situation results in serious semantic interoperability problems. The use of proprietary data models, taxonomies, code lists, etc. is hard and expensive to integrate in other e-government systems.

Social security institutions need to become aware of the importance of metadata in e-government and the need for coherent management policies.

Level 2 – closed metadata: Metadata may be partially documented but: a) not in a centralised and structured way or b) it is not available or accessible under an open license framework for developers to share and reuse.

Social security institutions should organize the scattered metadata in structured repositories, catalogues or libraries and provide open access to the collected resources.

Level 3 – Open metadata for humans: Metadata is documented and available as "Open Metadata" for reuse, but is not systematically published in a reusable format, e.g. it may only be available in the form of.pdf or.doc documents.

Social security institutions should provide services to query, browse and export their Metadata in a machine-readable and preferably non-proprietary format (e.g. CSV, XML).

Level 4 – Open reusable metadata: Metadata is centrally managed and published as "Open Metadata", in a machine readable format and/or an API is provided for computers to access, query and reuse the available metadata repositories, catalogues, libraries, etc. Through these systems users can find, browse, compare, download and use metadata that better fits their needs and projects.

Social security institutions should consider applying linked metadata policies, including the use of RDF to document their metadata, persistent design, use and maintenance of URIs, linking to external vocabularies/data schemas, harmonizing their resources to third parties' resources etc.

Level 5 – Linked open metadata: Semantic assets are documented using linked data principles and are managed by advanced metadata management systems. At this level a graph of interlinked concepts emerge, as metadata definitions make use of definitions from other vocabularies. Each concept represented in this graph corresponds to a unique URI.

Social security institutions should consider using anthologies, making use of OWL, for the representation of models of knowledge.

5.4. Technical dimension

Technical interoperability usually covers the technical aspects of connection and communication between teams, computer measures, applications and services. It includes key aspects such as open interfaces, interconnection services, the integration of data and middleware, the presentation and exchange of data, localization and recovery of resources, accessibility, security and the integration of applications and services. Different standards and extended use specifications such as those described below can be identified for each one these areas:

- **Interconnection:** Defines the policies and technologies for connection of systems through communication protocols such as TIC/IP, HTTP, FTP, SMTP, SOAP, CORBA and other protocols widely used on Internet.
- **Data exchange:** Based on technologies and standards for the description of the structure and codification of data in order to permit the exchange of information between systems which may have various forms of international representation of data. Some of the most commonly used standards at the present time are: universal systems for the encoding of characters such as Unicode, XML (eXtensible Mark-Up Language), mechanisms for the transformation and presentation of documents such as XSL (eXtensible Stylesheet Language), consistent extensions such as S/MIME (Secure/Multipurpose Internet Mail Extensions), among others.
- **Presentation of information:** Through the use of standardized file formats such as TXT, PDF, JPEG, PNG, HTML, XHTML, XML, etc., which can be easily understood and used by heterogeneous systems in order to accurately represent information from multiple sources.
- **Metadata for the description of procedures and data:** Description mechanisms such as the Entity Relationship Model are employed to structure the information in relational data bases or XML schema, which also permit definition of the structure and contents of different types of documents.
- **Localization and recovery of information:** This refers to the mechanisms used to search and localize resources (directory services such as DNS, or protocols such as LDAP to query networks, as well as to metadata standards and controlled vocabularies which enable the consistent description of resources, such as RDF (Resource Description Framework) or the definition of anthologies such as OWL (Ontology Web Language).
- **Business services:** Each business process comprises a set of integrated and coordinated services, the use of Web services being recommended for their implementation. These services rely on a group of XML-based standards (WSDL, 2001), (UDDI, 2004) y (SOAP, 2007). In addition to previous standards they will need to use standards known as the second generation “WS-*” Web services. We must also take into account the proposals of the organism responsible for defining and ensuring the interoperability of the Web services known as WS-I (Web Services Interoperability Organization) (WS-I). Service orchestration mechanisms such as Web Services Business Process Execution Language (WSBPEL, 2007) will be used for the coordination of Web services.
- **Integration of applications:** Allows successful interoperability and organization of the information flow between heterogeneous applications, i.e. ensure communication between the various applications. Outstanding technologies in this area are EAI (Enterprise Application Integration) and ESB (Enterprise Service Bus).
- **Integration of services:** What are known as service-oriented architectures (SOA) are used for the integration of services and business processes. This is a software architecture concept which defines the use of services to provide support for business processes. It permits the creation of highly scalable information systems which reflect the business of the organization, and provides a well-defined framework for the representation and recourse to services (usually Web services) which facilitates interaction between different systems whether owned or belonging to third parties.

Other technical aspects which have been underlined are those concerning the unique identification of resources (such as URI, Universal Resource Identifier) or elements and attributes used in XML schema or other metadata schemas (such as the spaces of XML names). The final issue concerns security; it is important to take into account other technologies and standards for the encryption of data, digital signatures and other protocols for the secure transmission of information.

The New Zealand E-Government Interoperability Framework (NZ e-GIF, 2008) provides a layered model which helps to understand the functions which a system must possess in each one of the constituent layers.

Figure 3. *NZ e-GIF layered model of technical interoperability*



The model is divided into four basic layers as follows:

- **Network:** covers the details of data transfer such as network protocols. This is a crucial area for interoperability. It is difficult or even impossible for systems to communicate without agreement on network standards.
- **Data Integration:** Facilitates the interoperability of data and its processing. The standards used enable different systems to exchange data and analyse the data received.
- **Business Services:** Enables the exchange of data in business applications and information contexts. Some of the standards in this level are of a generic nature, which covers a multitude of business information environments. Others work with the data integrations standards to define the meaning of data in order to combine them with business applications.
- **Access and Presentation:** This covers the way in which users access and use business systems.

In addition to these basic levels the model recommends that all the levels should take security issues into account as well as best practice in the use of standards. It also recommends the use of available e-government services by public sector organisations and the use of Web services for the interconnection of applications.

The most important technologies in technical interoperability, such as Web services, service-oriented architectures and ESB services are described in Annex III.

5.5. Model for the implementation of interoperability in social security

In the following pages we present a generic model for the implementation of interoperability which suggests ways in which the establishment and functioning of public services could be organized in social security institutions. The model is based on the EIF v2.0 proposal within the European Union Framework which studies its implementation in the public services of member states. The model helps to develop a conceptual model and a common vocabulary to improve the understanding of all the member states of the basic principles behind the implementation of an inter-institutional public service.

The model uses a "building-block" approach to setting up European public services, using interconnecting and reusable service components to build new services. The model is highly focused on the implementation of future services, so not all existing services are included in it.

The model is generic in the sense that it is applicable to the provision of public services at any level, from local to international. The model can also be used to clarify and rationalise the relationships among entities that work together (in the various levels of government, in different sectors or both) to deliver better public services.

To summarise, the aim of the model is to introduce practical benefits by establishing public services in such a way as to clearly define the functions of the services and their interfaces and thus enable their reuse. In this way we can avoid duplication of work and try to use the existing services to the best advantage, automating a wide range of basic practices and their use.

5.5.1. Key concepts

The model promotes the reuse of information, concepts, models, patterns, solutions, and specifications in each one of the social security institutions. Their public services are based on information from various sources located at different levels of the administration in different states. We should be able to combine basic public services which are constructed independently by social security institutions in different states.

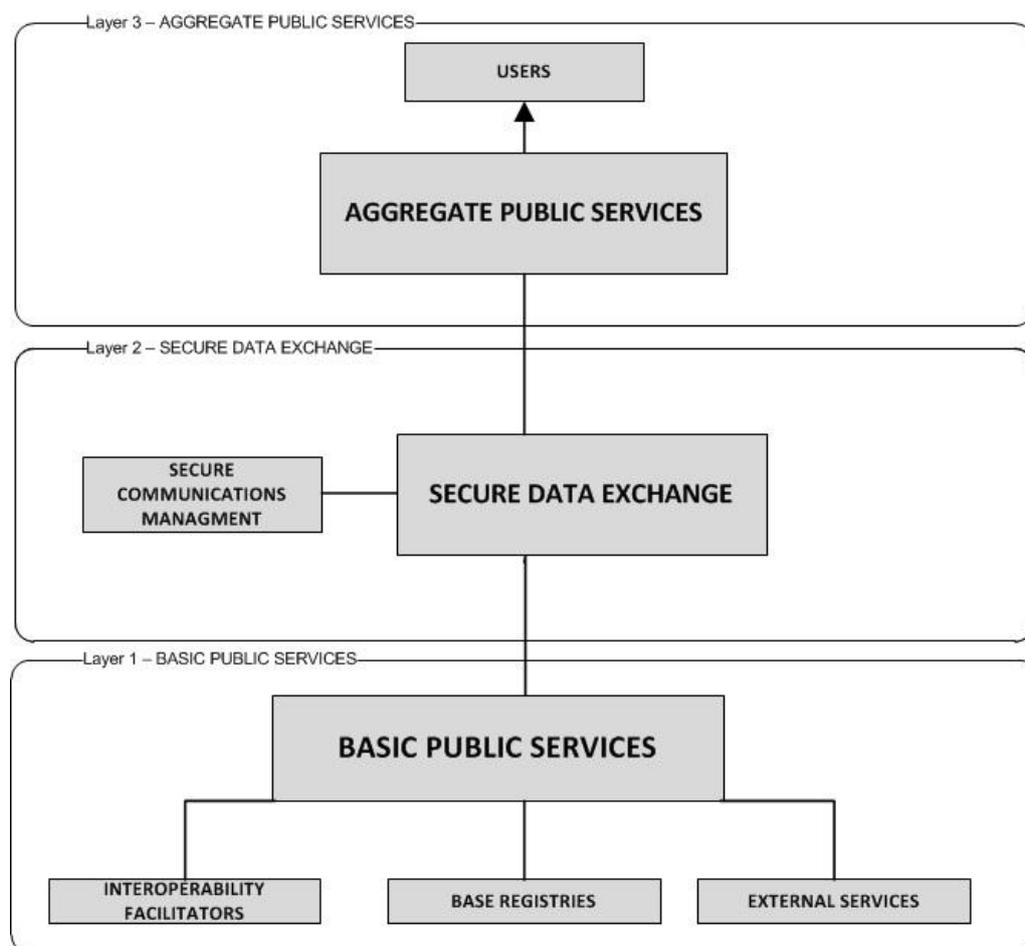
The model highlights the need for a modular infrastructure with loosely coupled service components which can be interconnected to deliver European public services. It calls for the adoption of service orientated architectures (SOA) for the design and development of institutional systems in order to package business processes as services.

The social security institutions should reconfigure their systems and applications in order to increase reuse and satisfy new user requirements. They should also integrate agreements for a component-based model at the service and operational policy level, which will also require an agreement for a joint scheme to interconnect the loosely coupled service components, and introduce the necessary infrastructure for the establishment of their public services.

5.5.2. Model layers

The model (Figure 4) has been divided into three layers: Basic public services, secure data exchange and aggregate public services, as shown in the figure below.

Figure 4. Conceptual model for social security interoperability



Level 1: Basic public services

The lowest layer of the model deals with the most basic service components from which social security public services can be built. It groups three types of components, namely services based on base registries, interoperability facilitators, and external services.

Some basic public services have been developed primarily for direct use by the public administration that created them or their direct customers, i.e. businesses and citizens, but are made available for reuse elsewhere in order to provide aggregate public services. Others are generic and/or infrastructural by nature, while the remainder represent external services, i.e. services provided by third parties. The following sections describe each type of basic public service in more detail.

Base registries or shared data sources

The basic registries or shared data sources (reliable sources of basic data) represent the “core” data of the social security sector. Such registries are under the legal control of the social security institutions and are maintained by them, but the information could be made available for reuse with the appropriate security and privacy measures.

The basic registries can take various forms, but their main characteristic is that they are validated and authorized by the corresponding administration. This means that such data registries contain pertinent reference data (not necessarily all the data) concerning citizens, businesses,

beneficiaries etc. which is considered valid. Generally speaking their content is not static; they reflect the information lifecycle which in the context of shared data, represents a challenge.

Access to authentic data sources between different administrations will be facilitated if the interfaces to these sources are published and harmonised at both the semantic and technical levels. This data may come from legacy systems, which may constitute an obstacle to adopting the model since these systems, and their data repositories have specific characteristics limiting the possibilities for reuse (e.g. lack of published interfaces), and they may require extensive reengineering in order to make their information available for public services.

In order to construct this type of information source, the institutions must evaluate their existing services (and the associated business processes) in order to identify and document the existing service components or business processes, including the business functions provided by the applications; the data used by the processes, the services provided by the systems and the functions carried out by individuals.

Adopting the modular approach described in the model for the construction of services means the implementation of building blocks and implies the establishment of secure levels of confidence for specific interactive activities, alongside the introduction of negotiated agreements between administrations which may take the form of memoranda of understanding and SLA, associated with the concept of well-defined interfaces in which other components (users of the service) can have confidence.

Interoperability facilitators

These are the basic mechanisms which provide services or act as information brokers to meet the needs of interoperability. In concrete terms, they consist of: protocol translators (gateways), format translators (e.g. XSLT), integration platforms (e.g. “Integration Brokers” and “Enterprise Service Bus”) and data, among others.

External services

These include services provided by external parties such as businesses or organizations which may be included in the provision of services such as: at information level – data concerning the civil status of individuals provided by other state departments; — at business level — payment services provided by financial institutions; or — at infrastructure level — connectivity services provided by telecommunications providers.

Level 2: Data exchange

This layer is central to the conceptual model since all access to basic public services passes through it.

From a business point of view, administrations and other entities exchange official information that may involve access to base registries. This should go through a secure, harmonised and controlled layer allowing information exchanges between administrations, businesses and citizens that are:

- signed and certified – both sender and receiver have been identified and authenticated through agreed mechanisms,
- encrypted – the confidentiality of the exchanged data is ensured;
- logged – the electronic records are logged and archived to ensure a legal audit trail.

In the proposed conceptual model, these functions are grouped in the 'secure data exchange' layer. This layer should allow the secure exchange of certified messages, records, forms and other kinds of information between the different systems. In addition to transporting data, this layer should also handle specific security requirements such as electronic signatures, certification, encryption and time stamping.

Security is potentially one of the main barriers to interoperability if it is not applied in a harmonised and agreed way among organisations.

The conceptual model calls on all service providers to: consider the security questions; cooperate on a common framework to meet their respective security needs via compatible mechanisms and commonly agreed specifications; reach a common understanding on essential characteristics such as levels of protection and levels of authorisation and authentication. Therefore, public administrations should agree on a common security framework when establishing a public service.

One of the key prerequisites for implementing the functionality expected in secure data exchange involves leveraging national identification and authentication infrastructures within the administrations. This scheme should establish which ICT architectures and data are needed in an interoperable context to make existing electronic infrastructures interoperable. The provision of secure (i.e. signed, certified, encrypted and logged) data exchange also requires several management functions, including:

- service management, to oversee all communications on identification, authentication, authorisation, data transport, etc., including access authorisations, revocation, and audit;
- service registration, to provide (subject to proper authorisation) access to available services through prior localisation and verification of authentication;
- service logging, to ensure that all data exchanges are logged for future evidence, and archived when necessary.

Level 3: Aggregation of public services

Aggregate public services are constructed by grouping a number of basic public services that can be accessed in a secure and controlled way. They can be provided by several administrations at any level, i.e. local, regional, national or international.

A typical aggregate service should appear to its users (administrations, businesses or citizens) as a single service while transactions may be between different administrative units. Aggregation is accomplished via mechanisms tailored to specific business requirements. for example through orchestration or workflow engines.

Nowadays, users expect to access public services not solely through government portals or websites but also via intermediaries with whom they are in contact on a regular basis. Therefore, public services should be developed in such a way that they can easily be integrated in intermediaries' websites through mechanisms such as mash-ups and widgets, without government losing responsibility for the services themselves and with clear indications enabling users to tell the difference between private and public services.

If aggregate public services are provided by intermediaries, public administrations should establish:

- an authorisation procedure to determine which basic public services may be disclosed to which intermediary; and
- a procedure for certifying intermediaries to establish trust between users and service providers.

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