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Open Government Architecture: The evolution of *De Jure* Standards, Consortium Standards, and Open Source Software

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Open Government Architecture: The evolution of *De Jure* Standards, Consortium Standards, and Open Source Software

François Coallier[1], Robert Gérin-Lajoie[2]

Abstract

Conducted for the Treasury Board of Québec, this study seeks to present recent contributions to the evolution, within an enterprise architecture context, of *de jure* and *de facto* standards by various actors in the milieu, industrial consortia, and international standardization committees active in open source software.

In order to be able to achieve its goals of delivering services to citizens and society, the Government of Québec must integrate its computer systems to create a service oriented open architecture.

Following in the footsteps of various other governments and the European Community, such an integration will require elaboration of an interoperability framework, i.e. a structured set of *de jure* standards, *de facto* standards, specifications, and policies allowing computer systems to interoperate.

Thus, we recommend that the Government of Québec:

- Pursue its endeavours to elaborate an interoperability framework for its computer systems that is based on open *de jure* and *de facto* standards. This framework should not only reflect the criteria enumerated in this study and apply to internal computer systems, but it should also extend to Web services supplied to organizations outside of the government. This framework should explicitly prioritize open source *de jure* and *de facto* standards and include a policy covering free software. The interoperability framework should initially draw on that of the state of Massachusetts. In the medium term, is should be as comprehensive as that of the British government.
- Integrate this interoperability framework into its enterprise architecture.
- Publish this interoperability framework with its enterprise architecture.
- Specify this interoperability framework in its calls for tenders.
- Elaborate a policy of compliance with this framework for all new applications.

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1. Background and Issues

Conducted for the Treasury Board of Québec, this study seeks to present recent contributions to the evolution, within an enterprise architecture context, of *de jure* and *de facto* standards by various actors in the milieu, industrial consortia, and international standardization committees active in open source software. This evolution also encompasses open source software. These two developments create a synergy benefiting both, and making a service oriented open source architecture possible.

Governments have long included standards in their competitive procurement policies and in their product specifications in calls for tenders.

However, this policy must continually be updated. In 2004–2005, the Government of Québec published its *Cadre Commun d'Interopérabilité* which took stock of the *de jure* and *de facto* standards that the government must implement in an e-governance framework: Le *Sous-secrétariat à l'inforoute gouvernementale et aux ressources informationnelles* (SSIGRI) proposed a shared interoperability framework. The Government of Québec`s shared interoperability framework (SIF), a true repository for materials on information technology, is a set of *de jure* and *de facto* standards for computer resources designed to support interoperability of the Government's systems.[1]

However, many individuals active in the field evoke the difficulties that waylay an approach based on a list of relevant standards, as the document *Interoperability Theory and Practice*[2] quite rightly points out.

Some facts of life surrounding standards and interoperability

- *Not all "standards" are really standards in any meaningful sense of the word. Just because something is "standard"—especially in software—does not magically provide any degree of interoperability guarantees.*

- *It is possible for a technology to be both "standards compliant" and "100% proprietary"—either to a platform or a vendor—at the same time*

- *Some of today's most vaunted technology "standards" will be completely obsolete in five years time. The volatility of standards continues to increase year on year.*

- *There is much that can be adopted and re-used in existing standards that can aid interoperability. However, doing so without taking care to remove redundancies and contradictions will actually create more interoperability problems than it solves.*

- *XML does not magically provide interoperability. XML facilitates it, but does not provide it, inforce it or measure it. It is up to humans to implement interoperability on the platform that technologies such as XML provides.*

- *Simply interconnecting systems does not make them interoperate. "Interconnectivity" and "interoperability" are two very different concepts. In particular, two systems could be entirely based on widely recognised, open standards (Web, XML etc.) and yet be utterly unable to talk to each other.*

The same document also emphasizes the importance of profiling standards in order to construct interoperability scenarios.

Profiling Standards for Interoperability

- *The best way to re-use existing standards to maximise interoperability is to reuse the most interoperable subsets of them. This process is known as "profiling". Many of today's "new" standards are in fact profiled versions of old standards.*

- *Any existing interoperability standard that has not been through at least one profiling phase is unlikely to have been proven in the real world and thus should be treated with caution.*

- *A well known mechanism for tying a system into one particular technology is to* *initially embrace a de-facto or de-jure standard—such as SQL or HTML or RS-232 or Unix—and then slowly add features to your implementation that are specific to your implementation. This is known in the industry as "embrace and extend".*

- *The key tool in the creation of truly inter-operable technologies is to perform the opposite of embrace and extend namely embrace and constrain—profiles.*

- *Profiling and (sic) is a widely used technique. Sometimes it is at work without users of the resulting standards even realising that profiling has occurred. To pick just three examples: XML, LDAP and Unicode are well known examples of standards in web technology at the start of the 21st century. It is less well known that they are themselves profiled versions of much older standards namely SGML, X.500 and ISO 10646 respectively.*

This profiling allows construction of interoperability usage scenarios, along with exhaustive compliance and performance testing. Such a process allows public and parapublic bodies to precisely define their needs, test the proffered computer-based solutions, and finally select their technological environment. It also makes the implementation of service oriented enterprise architecture possible.

Given this context of the open selection of solutions based on accessible standards, open source software becomes a model for creating powerful software. An example from France's department of finance illustrates our contention. After selecting a set of interoperable technological standards, they programmed a comprehensive series of tests and evaluated the systems offered in response to an open and competitive call for tenders. Finally, a proposal based on open source software proved the most competitive, in terms of quality, performance, and cost…by a wide margin.[3]

2. Computer interoperability in an organizational and governmental framework

2.1. *Definition of interoperability*

Computer interoperability is defined as follows:[4]

> *The capacity of two systems to understand each other and function with synergy. Opposite: incompatibility.*

Despite being succinct, this definition captures all elements of interoperability:

1. *The capacity of two systems:* this is about machine-to-machine (M2M) communication.
2. *…to understand each other:* this implies that, beyond the capacity to communicate, they are also able to share data, metadata, documents, etc.
3. *…and work in synergy:* this implies that the two systems function in a complementary fashion, making it possible for them to jointly provide a useful service.

Interoperability is thus made possible by:

- Shared compliance with a set of generic *de jure* and *de facto* standards;
- Compliance with a set of architectural conventions;
- A modular architecture that defines the framework within which these standards and conventions apply.

It is important to emphasize that all three elements are necessary. Indeed, even if the first two are in place, the absence of the third will make it very difficult to integrate applications, since their functionalities will not be complementary.

2.2. *Why interoperability?*

In this post-industrial age, our society has become part of a global village in which the Internet plays the role of the nervous system and the information that flows through it that of nerve impulses. Societies and organizations belonging to it have become very dependent on this infrastructure.

For organizations (governments, companies), the Internet constitutes an infrastructure allowing communication with the outside world, and also a medium for integrating geographically dispersed components, while Intranets perform the same function internally.

Information has always been central to the functioning of any organization. Their internal processes are based on exchanging information. Consequently, any technology that facilitates these exchanges has an impact on the internal functioning of organizations and on their interactions with clients, suppliers, and partners.

Interoperability of an organization's computer system thus has direct impacts on the internal functioning of the organization. These impacts are:

- Greater process efficiency. This efficiency may take the form of faster turnover times, reduced resource use, fewer errors, and increased security.
- The potential for setting up new procedures that would be impossible without interoperability of computer systems.
- The potential for offering new services that would be impossible without interoperability of computer systems.

2.3. *Interoperability in the governmental context*

When properly implemented in a governmental context, computer systems interoperability specifically translates into:

- the possibility of one-stop service delivery;
- automation of user transactions;
- greater efficiency in the provision of services to citizens;
- better protection against fraud based on identity theft;
- better protection for the government against tax fraud.

If poorly implemented, interoperability creates high integration costs. It can also result in security problems affecting the protection of citizens' data. All of these problems can be managed at the systems architecture level, as well as through use and management policies.

A typical example of the potential benefits from integrating government systems arises at the death of a citizen. At present, a variety of actions must be explicitly undertaken to change the status of the deceased in various government databases and private services. One of the authors experienced this first-hand at the death of his parents. He was surprised to learn that the issuing of a death certificate does not automatically trigger an update of all government databases. This lack of integration between government systems is not only an inconvenience, but potentially opens the door to various types of fraud based on the theft of the identify of deceased citizens.

Compared to large private firms, the health sector is considered to lag some fifteen years in its use of IT. This is attributable to factors that are both technological (the initial absence of interoperability standards, high multimedia content, etc.) and socio-cultural (limited familiarity with IT among physicians and medical staff, concerns regarding protecting privacy and medical files, etc.). Technological advances and the rise in healthcare costs provide the main incentives, not only for the development of many standards in the field,[5] but also for the realization of integrated computer systems.

This last example also illustrates that *de jure* and *de facto* standards are simply technological tools that permit computer systems to be integrated. The main challenges confronting systems integration are usually not at the technological, but rather at the organizational, level (procedures, managing change, etc.).

2.4. *Interoperability as a prerequisite for e-government*

With the expansion of the Internet, citizens and companies expect governments to improve the delivery of services by using this technology. In recent years, this has given rise to a sweeping expansion of so-called *e-government* in industrialized countries.

Implementation of e-government services requires integrating all the computer systems that contribute to them. This can be clearly seen in the example illustrated in Figure 1, *The architecture of an online brokerage portal*, from the IBM Web site on architectural patterns and e-commerce.[6]

We observe that this type of service portal incorporates the following elements:

- A client interface that supports different types of terminals (PC based browser, PDA based browser, wireless);
- A functionality of aggregating information from various sources;
- A user-transaction function;
- A back-office (integrating infrastructure-level transactional systems);
- A function integrating inter-organizational infrastructure-level transactional systems.

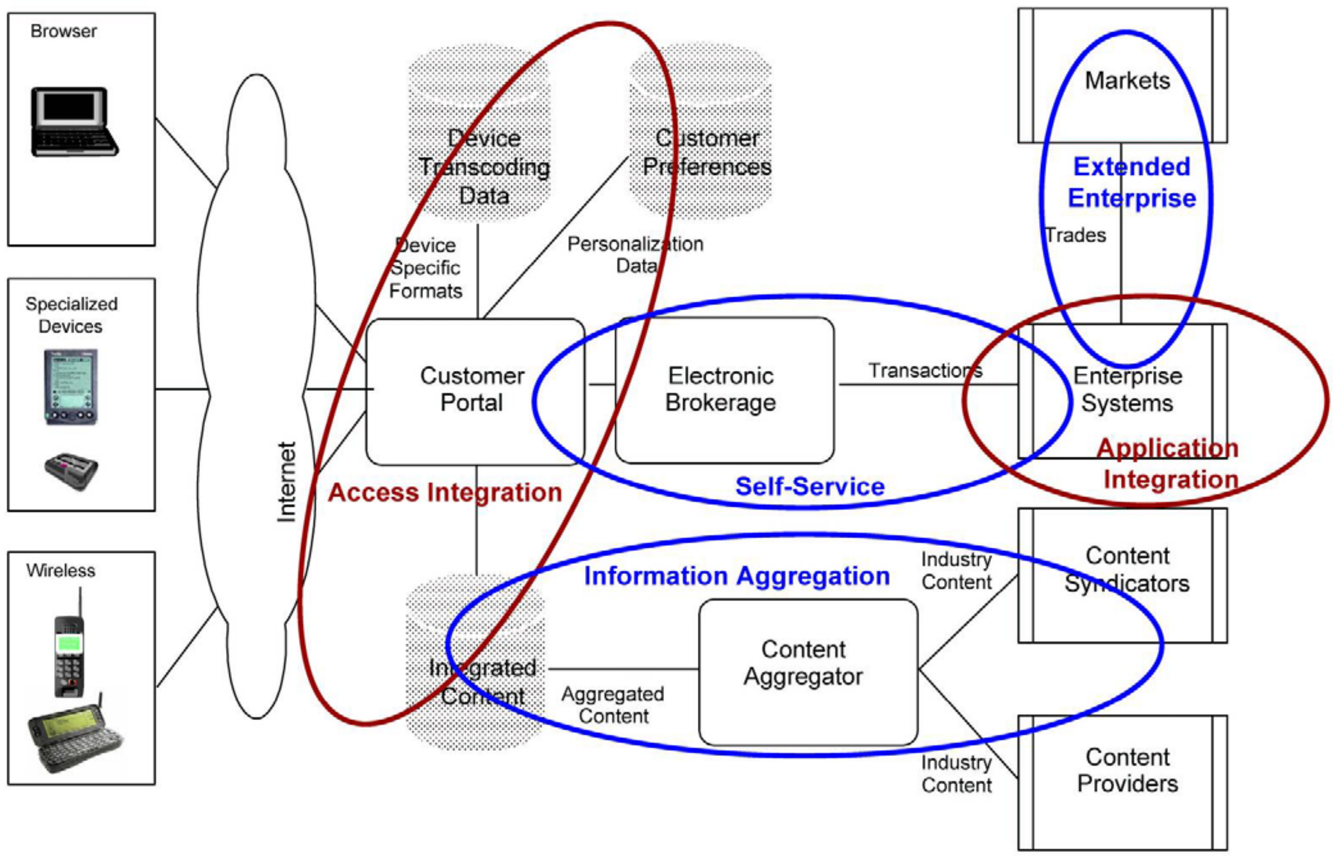

Figure 1: The architecture of an online brokerage portal[7]

The conceptual patterns used in this example are found in all applications of this type, including online government applications whose clientele is citizens and organizations.

3. Interoperability standards

3.1. De facto and de jure standards and specifications

For purposes of discussion, it is now necessary to differentiate between distinct and complementary concepts. The *Direction du soutien au déploiement de l'inforoute gouvernementale* of the Québec *Sous-secrétariat à l'inforoute gouvernementale* has already documented the use of these terms. It is of some value at this point to distinguish between *de facto* and *de jure* standards. While similar, the two concepts are not always interchangeable. A *de facto* standard is essentially a private normalization object. “Private” in the context means that it is specific to an organization (private firm or even government) and has not necessarily garnered a consensus on the international, or even domestic, level. *De jure* standards, on the other hand, are limited to those that are established by an institution specifically created for the purpose and that releases specification documents based on a global consensus-building enquiries.

To summarize:

- ***De jure* standard**: a standard adopted by an official standards setting body, whether national or international.
- ***De facto* standard**: a standard that has not received the sanction of any official body (such as ISO, AFNOR), but has imposed itself by eliciting a consensus among users, a group of firms, or a consortium.

These terse definitions make it clear that *de facto* standards refer to industrial practices that are common to one or several firms, while *de jure* standards are a matter of national and international regulation. Thus, we find a continuum ranging from private, industrial standards to international standards. However, *de facto* and *de jure* standards must meet certain basic criteria before being considered open and truly creating interoperability:

a) their definitions are accessible to all;

b) their use is not conditional on fees being paid to an owner;

c) at least one reference implementation exists; and, finally

d) tests exist to validate system compliance with them.

One of the most important features of *de jure* and *de facto* standards is that their specifications are published and maintained by arms-length organizations (in business terms), rather than by specific developers. Consequently, everybody has access to them and may use them to develop software based on the specifications they define with no risk of violating intellectual property rights or the claims of their developers. Implementations of these specifications proliferate, sometimes governed by proprietary licences and sometimes by free and/or open source licences.

3.2. The main actors: consortia and "de jure" organizations

Several types of organizations are involved in developing *de jure* standards in information technologies.[8] They are:

- For-profit companies. Generally, their purpose is to control a specific market by creating *de facto* standards. Examples of this type of standard are the Windows operating system, the CDMA[9] cell phone communications protocol, and the ABAP language used in the SAP R/3 environment.[10] Adobe created the standard for "portable document format" (PDF). This standard is open, easily accessible, well documented, and very nicely illustrates a *de facto* standard developed by a single company.

- Professional bodies. An example of this type of *de jure* standard is provided by the wireless standard Wi-Fi, developed by the IEEE.[11]

- Industrial consortia and communities of experts. These groups, including the OMG, the W3C, OASIS, WS-I, and the IETF, are very active in the field of IT standards, to the point of generating the vast majority of them. Thus, XML standards are created by a consortium of industry and experts, the W3C. The·ETSI (European Telecommunications Standards Institute) has 489 member organizations.[12] The bulk of e-commerce standards were developed by industrial consortia.

- Finally, there are the so-called *de jure* organizations, such as ISO, IEC, ITU and UN/CEFACT. These organizations are usually configured around national representation.

Some twenty years ago, international *de jure* standards were almost exclusively based on national standards. It is worthwhile noting that this is no longer the case (Figure 2). Several mechanisms exist to facilitate the migration of consortium standards, once they are stable, to *de jure* organizations.

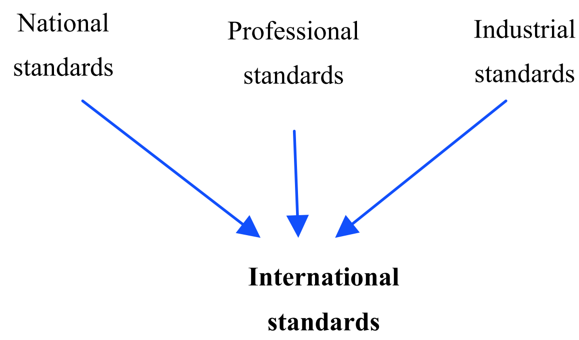

Figure 2: Migration of Standards

This migration is partly motivated by the reputation for stability and integrity of *de jure* standards.

3.3. Interoperability standards and the OASIS model

The Organization for the Advancement of Structured Information Standards (OASIS) is a non-profit consortium of firms and experts active in the development and adoption of e-commerce standards. This organization is known for its leadership in the elaboration of new standards for Internet business, online government, and Web services. Technical committees are constituted to develop, vote on, and then register specifications, which are, in turn, reviewed, commented, and, if accepted, transformed into standards. Among the standards registered with OASIS that merit mention are: ebXML for e-commerce, SAML for managing shared identities, and DOCBOOK for the XML description of computer manuals. The same is true for the XML format of the OpenOffice office suite, which is registered with OASIS. A technical committee exists for this format, called the OASIS OpenOffice XML Format TC. There are nearly forty technical committees.

To understand the hierarchy of *de jure* and *de facto* standards required for M2M transactions and e-commerce, let us take a closer look at the OASIS B2B model (Figure 3).

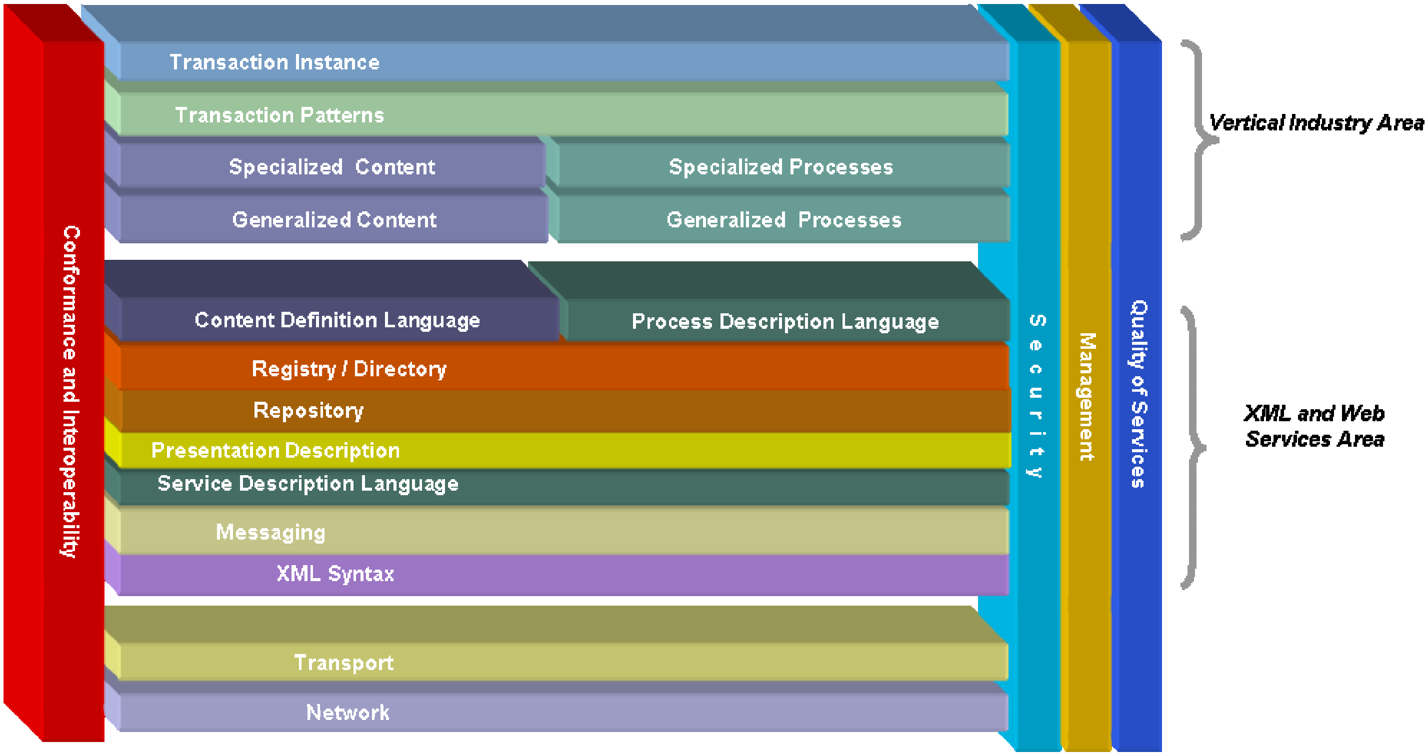

Figure 3: The OASIS B2B e-commerce model[13]

This model differs from the traditional layered OSI (Open System Interconnection)[14] model in the following ways:

- It is essentially application oriented: All the layers of standards rely on networking and Internet technologies.
- *De jure* and *de facto* standards are defined in XML, the W3C's meta-language.

The purpose of the family of standards and specifications found in this model is to allow computer systems to find each other, interface, and execute a transaction. This, in particular, implies *de jure* and *de facto* standards to:

- Define the services.
- Create a roster of these services.
- Define how to interface with the system running these services. This requires specifications for meta-data, data, documents, and transactions. These specifications must be interpretable by

computer systems.
- Execute these transactions in a secure and reliable fashion.

For this vision to become reality, *de jure* and *de facto* standards are not only required for infrastructure, but also specifically for applications involving meta-data, data, documents, and transactions. For example, OASIS has task forces defining such standards in the fields of e-government and law,[15] as well as for the supply chain[16] and health.[17]

The OASIS model also illustrates that interoperability between systems requires a harmonized and complementary set of *de jure* and *de facto* standards.

The set of all *de jure* and *de facto* standards encapsulated in the OASIS model is known as Web Services. While extensions around this technology are still evolving, several products that comply with its standards are already on the market (J2EE, IBM WebSphere, Microsoft .NET, etc.). A consortium with the task of defining interoperability profiles for these products has even been formed, WS-I[18] (Web Services Interoperability). It is of some interest to note that the two founding members of these organizations are IBM and Microsoft.

3.4. Interoperability frameworks

3.4.1. Definition and purpose

As we have seen, interoperability is a prerequisite for the delivery of online government services.[19] Also, we saw in the case of the OASIS model that interoperability requires a harmonized and complementary set of *de jure* and *de facto* standards. Depending on its level of sophistication, this set makes varying levels of interoperability possible. This is illustrated in Figure 4.

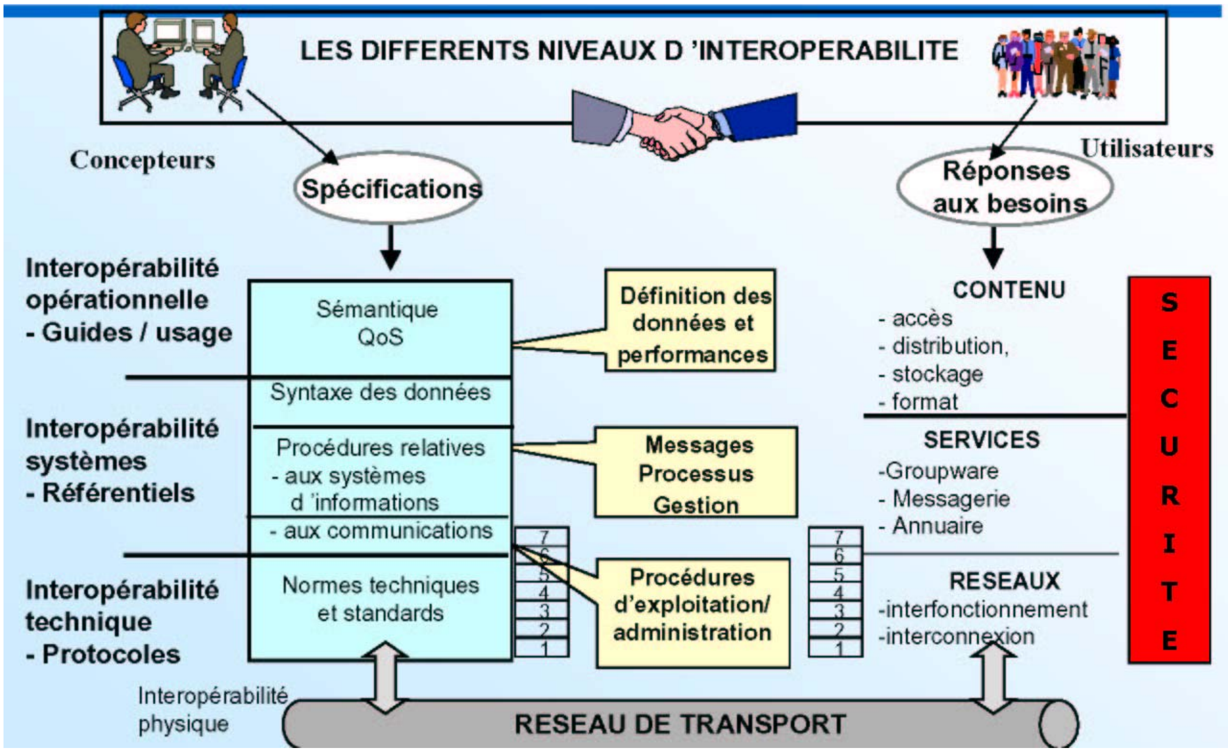

Figure 4: Different levels of interoperability[20]

Indeed, Figure 4 reveals very clearly that a set of *de jure* standards, *de facto* standards, and conventions is associated with each level of interoperability. This set makes up what we call the interoperability framework.

3.4.2. Contents

We define an interoperability framework as:

> *A structured set of de jure standards, de facto standards, specifications, and policies allowing computer systems to interoperate.*

The contents of an interoperability framework depend upon its goals. The greater the desired degree of interoperability, the more detailed the framework will be.

A complete framework should cover the following elements in a structured fashion (adapted from the reference[21]):

- Interconnections: policies, *de jure* standards, and *de facto* standards for interconnecting the systems. This should also cover middleware;
- Data integration;
- Meta-data *de jure* and *de facto* standards;
- Access: what interface types are supported (browsers, etc.);
- *De jure* and *de facto* standards associated with different application domains:
    - data, meta-data, documents,
    - transactions, processes.

An interoperability framework is of little use if no policy on its use is documented, promulgated, and adhered to. For this, a management structure for application of this framework must be in place.

Like all standards in enterprise architecture, an interoperability framework must be able to evolve as a function of needs and changes in technology and IT markets.

3.4.3. Examples of interoperability frameworks

<u>Introduction</u>

To understand the challenges inherent in designing interoperability frameworks, let us take a simple example in the field of security. The Kerberos protocol is a well-known standard for one of its aspects, managing identity tokens within enterprise networks. This standard has existed since 1993, and its version 5 is defined by RFC 1510. Many systems, open source and proprietary, implement it, both on the server and the client side: AIX, HPUX, IBM-z/OS, IBM-OS400, Sun Solaris, Linux, MAC OS X, Microsoft Windows 2000/XP, and Novell, in both the open source and proprietary form. However, to work properly this protocol requires that system clocks are well synchronized, for example with the xntp protocol.

Thus, to create interoperable systems, it is necessary to involve functional blocks and adhere to the architecture of the services, especially for each of the dependency links.

Preliminary inventory of governmental interoperability frameworks

Several governments have published interoperability frameworks, notably:

- The European Community:
  http://i-policy.typepad.com/informationpolicy/2005/02/european_intero.html

  http://www.comptia.org/sections/publicpolicy/docs/interopwhitepaper0204.pdf

- The Government of Ireland: http://www.reach.ie/interoperability/; http://sdec.reach.ie/rigs

- The Government of the United Kingdom:
  http://www.govtalk.gov.uk/schemasstandards/egif.asp

- The Government of the United States:
  http://www.whitehouse.gov/omb/egov/

  https://www.feams.gov/

- The Maryland State Department of Education:
  http://www.msde.state.md.us/technology/technical.html

- School's Interoperability Framework Association: http://www.sifinfo.org/

- The State of Kentucky:
  http://enterpriseit.ky.gov/

  http://gotsource.ky.gov/dscgi/ds.py/View/Collection-183

- The State of Massachusetts:
  http://www.mass.gov/portal/index.jsp?pageID=itdhomepage&L=1&L0=Home&sid=Aitd

- The Government of France: http://www.adae.gouv.fr/article.php3?id_article=219

- The Government of New Zealand:

  http://www.e-government.govt.nz/interoperability/index.asp

- The Government of Australia:
    - Federal: http://www.agimo.gov.au/practice/framework
    - The Government of New South Wales: http://www.oit.nsw.gov.au/content/5.5.36.interoperability.asp
    - The Government of Western Australia: http://www.egov.dpc.wa.gov.au/index.cfm?fuseaction=projects.egif

- The Government of Hong Kong: http://www.info.gov.hk/archive/consult/2002/egovt.pdf

- Government of Québec: http://www.services.gouv.qc.ca/fr/enligne/standards/index.asp

A comparative study of these frameworks would be required to elaborate a framework for the Government of Québec, but that is beyond the scope of this document.

Two of these frameworks retained our attention after a summary examination: those of the British and Massachusetts governments.

The British government's interoperability framework

We find that the criteria used by the British government to elaborate its framework are the most pertinent:[22]

- *interoperability—only specifications that are relevant to systems' interconnectivity, data integration, e-services access and content management metadata are specified*

- *market support—the* specifications *selected are widely supported by the market, and are likely to reduce the cost and risk of government information systems*

- *scalability—*specifications *selected have the capacity to be scaled to satisfy changed demands made on the system, such as changes in data volumes, number of transactions or number of users*

- *openness—the* specifications *are documented and available to the public*

- *International standards—preference will be given to standards with the broadest remit,* *so appropriate international standards will take preference over EU standards, and EU standards will take preference over UK standards.*

The implementation policy for the framework is also relevant:

- *alignment with the Internet: the universal adoption of* common *specifications used on the Internet and World Wide Web for all public sector information systems*

- *adoption of XML as the primary standard for data* integration *and data management for all public sector systems*

- *adoption of the browser as the key interface: all public sector information systems are to be accessible through browser-based technology; other interfaces are permitted but only in addition to browser-based ones*

- *the addition of metadata to government* information *resources*

- *the development and adoption of the e-GMS,* based *on the international Dublin Core model (ISO 15836)*

- *the development and maintenance of the GCL*

- *adherence to the e-GIF is mandated* throughout *the public sector. Section 6 provides more detail*

- *interfaces between government information systems and intermediaries providing e-Government services shall conform to the standards in the e-GIF. Interfaces between intermediaries and the public are outside the scope of the e-GIF.*

We also observe the areas of business covered by this interoperability framework:

- *business object documents*
- *content syndication and synchronization*
- *defense*
- *e-commerce*
- *e-Government*

- *e-learning*
- *e-news*
- *e-voting*
- *finance*
- *geospatial data*
- *health*
- *health and community care*
- *human resources management*
- *legal document management*
- *logistics*
- *purchasing*
- *virtual reality*
- *Web services*
- *workflow.*

Finally, the management of this framework is assigned to a centralized government agency, the Cabinet office (cf. http://www.cabinetoffice.gov.uk/) with the following responsibilities:

- *lead the development and maintenance of the e-GIF and provide the management infrastructure to support the processes*

- *act as the focal point for co-coordinating interoperability efforts throughout government and ensuring a rapid response to government proposals and priorities*

- *manage co-ordination with other governments and international bodies*

- *co-ordinate the development and maintenance of:*

  - the TSC
  - agreed XML schemas for use throughout government
  - the GDSC
  - the e-GMS
  - the GCL
  - advice on toolkits for interfaces and conversions
  - best-practice guidance

- *manage the government and industry-wide consultation process*

- *manage the http://www.govtalk.gov.uk website*
- *maintain a register of known users in the public and private sectors*
- *manage the Government Schemas Group*
- *manage the Metadata Working Group*
- *manage the Smart Cards Working Group*
- *manage the compliance process and ensure that interoperability policies and roles are adhered to*
- *manage interaction with similar initiatives and specifications bodies elsewhere across the world, including W3C, WS-I, IETF, OASIS, DCMI and others.*

The interoperability framework of the Government of the State of Massachusetts

Like the British Government,[23] the Government of Massachusetts retained our attention owing to its promulgation of a very explicit policy on the use of *de jure* standards and open source software.[24] The policy is summarized as follows:

- *All prospective IT investments will comply with open standards referenced in the current version of the Enterprise Technology Reference Model.*
- *Existing IT systems will be reviewed for open standards compatibility and will be enhanced to achieve open standards compatibility where appropriate. Open standards solutions will be selected when existing systems are to be retired or need major enhancements.*

The goal of their interoperability framework, called *The Enterprise Technical Reference Model*[25] is:

- *Ease of integration of applications, application services and data to enable inter-agency collaboration and sharing.*

- *Increase level of application interoperability within the Commonwealth, with other states and municipalities, and with the Federal government.*

- *Better responsiveness to changing business needs and rapidly evolving information technologies.*

- *Faster deployment of new applications.*

- *Efficient sharing and re-use of current information technology assets.*

- *Expand the consideration of possible alternatives as part of a best value evaluation of potential information technology solutions.*

- *Reduce the level of resources and costs required to develop, support and maintain government applications.*

- *Enable the consolidation of the state's information technology infrastructure to reduce costs, improve service levels, and increase operational flexibility across the enterprise.*

It covers the areas in Figure 5.

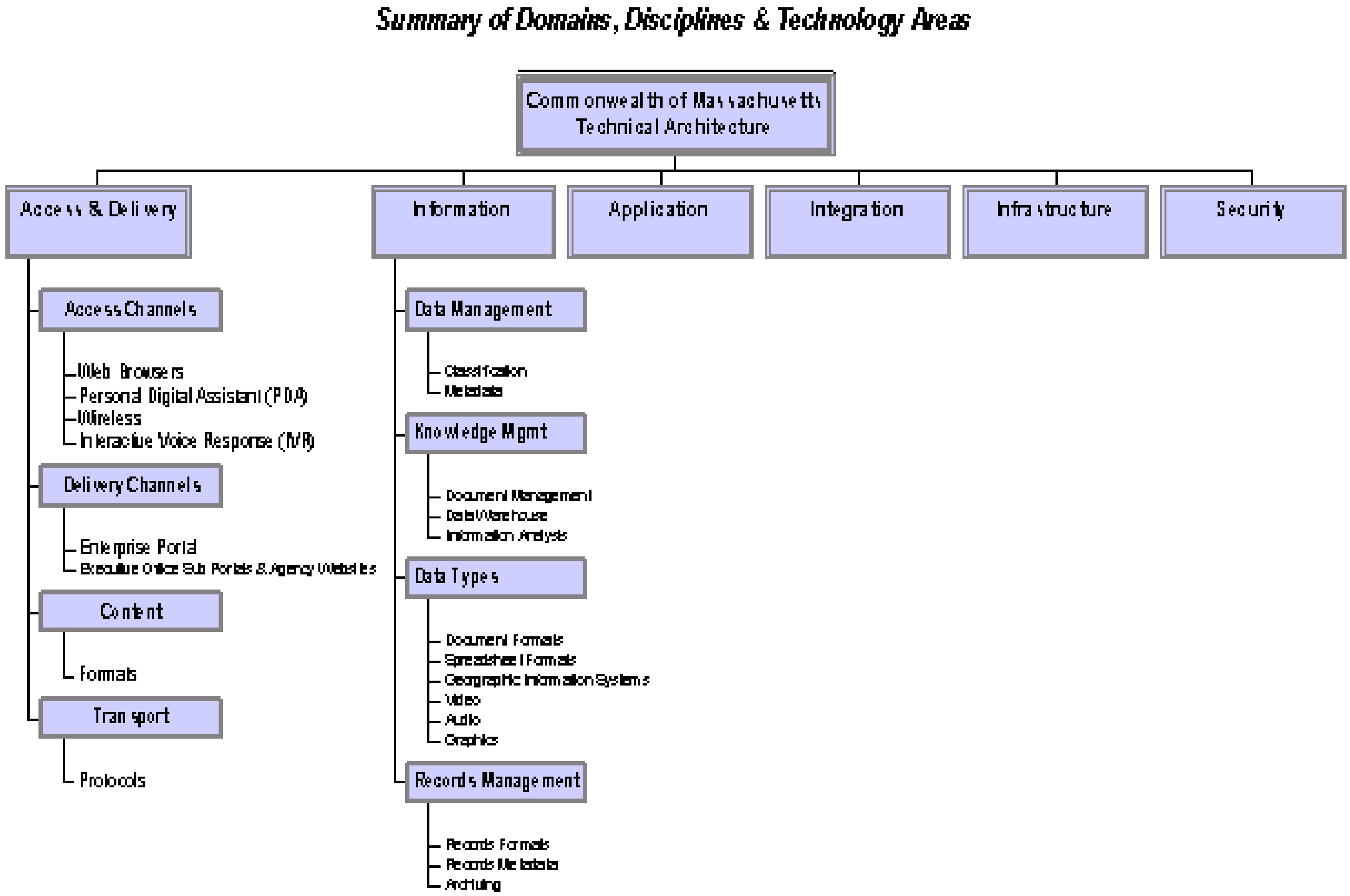

Figure 5 : Domains covered by the interoperability framework of the State of Massachusetts

It is organized around the architectural model depicted in Figure 6.

An online document succinctly describes the *de jure* standards associated with the five technical domains.

Conclusion

A cursory comparison of the two interoperability frameworks provided as examples reveals that the British framework is considerably more detailed and comprehensive than that of Massachusetts.

Indeed, while the Massachusetts interoperability framework deals with policies and *de jure* and *de* *facto* standards, that of Britain extends to some metadata[26] as well as data dictionaries and the XML document format.[27] Thus, if implemented, the British framework will yield a greater degree of interoperability.

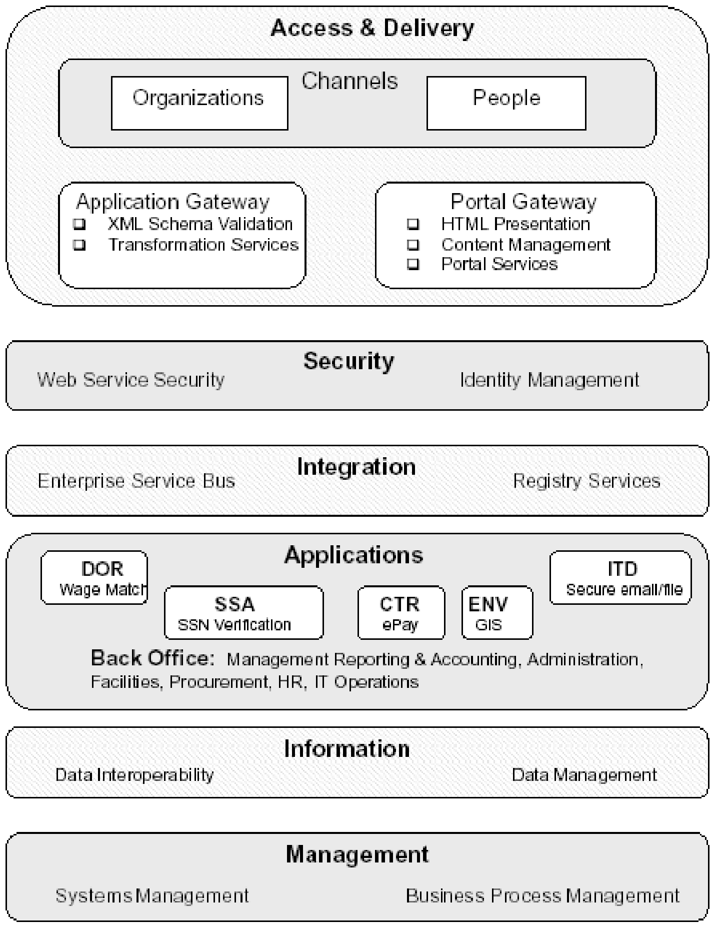

Figure 6: Architectural model of the interoperability framework of the State of Massachusetts

4. *De jure* standards and open source and free software

4.1. The synergy between open standards, de jure standards, and open source software

Open standards and *de jure* standards are at the core of governments' open architecture, since they allow users to choose between several competing platforms to accomplish a business function, while ensuring the longevity of the investments and selected solutions. Open standards are essential for protecting the economic interests and technologies of the users, public administrators, and the firms supplying IT services.

However, to fully benefit from open standards and interoperability frameworks, the governance of their selection and utilization must also involve integrating open source software. The synergy between open standards and open source software is, indeed, vibrant: Open standards require free software to ensure generalized dissemination, while free software that is based on open standards can be embedded in the architecture of large organizations. Consequently, the benefits arising from this synergy are reciprocal.

Furthermore, the importance of standards being truly open does not preclude, a priori, any specific method of managing intellectual property. Indeed, we have recently seen initiatives by several companies to include the standards produced by W3C and OASIS in "software patents," the terms of use of which are determined by their owner. In particular, it is important to ensure that no fees can be charged for the use of a standard, as this would significantly impede the generalization of its use, with each company and community then preferring to develop its own.

4.2. The contribution of free and open source software to the lifecycles of de jure and de facto standards

A standard has a lifecycle, from a technical perspective, that can be characterized by three phases: incubation, dissemination, and generalization. The incubation phase usually concludes with a reference implementation, test software, and a certification of interoperability. The dissemination of a standard usually begins with a few pilots based on it, followed by a large number of applications, some of which are open source and others proprietary. During this phase dynamic competition benefits users. Finally, during the generalization phase, it has become deeply embedded in organizational infrastructures.

Free and open source software contributes an essential value added throughout the lifecycle of *de jure* and *de facto* standards.

1- *The incubation phase*

During this phase, open source software must ensure conformity between the standard and its reference implementation. Opening up the process also makes possible contributions from the cumulative experience of various sectors of the community. Finally, the existence of tests that are specific to the standard and easily accessible allows users and organizations to validate their software's compatibility with this standard.

2- *The dissemination phase*

During this phase, the availability of an open source reference implementation enables organizations to validate the concept with small-scale pilots and, frequently, if the implementation is of high quality, this is also when some avant-garde developers come out with the first productions.

3- *The generalization phase*

During this phase, a number of software applications and systems support this standard, and its use by organizations has become widespread, sometimes even pivotal. Competition and interoperation amongst these systems is pervasive, involving several free, and several proprietary, platforms. One or several free and open source software programs compete with, or complement, proprietary software, all using the same interoperability standard.

During all phases of the standard's lifecycle, the presence of one or more free and open source software programs attests to its acceptance by the community and the IT market. It then becomes beneficial for an organization to devise its enterprise architecture around such a standard, since this will provide it with a range of solutions.

We may, indeed, assert that an essential criterion for assessing the quality and dynamism of a *de jure* or *de facto* standard is the existence of free and open source software that supports it. A solid standard adopted by the industry and the community can be said to nourish to a flourishing ecosystem: free and proprietary software, documentation, compliance tests, and all manner of services (architecture, customized development, training).

4.3. *The contribution of open standards to free software*

For organizations that are large-scale users of computer systems and information technologies, adhering to an open enterprise architecture and good governance is essential for successfully preserving the stability and longevity of the services.

The choice of any software or system, whether proprietary or free, entails certain technological risks. The following risks are particularly inherent in free software:

- The large number of projects available may impede the emergence of a leader and render identification of the best software more difficult.
- The risk of the project disappearing, because it is abandoned by its community and financiers, concomitant with the appearance of a derivative and competing project (forking).

As in any decision regarding the choice of software, the firm must explore the total cost of ownership (TCO), transition costs, and the direct and indirect risks associated with implementing software. These issues are the subject of a lively debate. It appears that the answer largely depends on the firm and the type of software under consideration.

In all cases, however, software that complies with open standards provides assurance to the organization or firm that the system will be interoperable with other components. As a consequence, it will be possible to replace it in the future by a more appropriate system, whether free or proprietary, should the need arise.

4.4. *Examples of synergy*

For a long time open, *de jure* and *de facto* standards have had a synergy with free software. Open standards define inter-system exchanges and provide a perennial architecture. On the other hand, open source software ensures the broad dissemination of standards and allows a rich ecosystem to flourish. The Table “Functionality, open source software and standards” illustrates this synergy.

	Functionality	Open source software	Standards	Comments
Personal computer	Browser	Mozilla-Firefox Konqueror	HTTP HTML XHTML FTP	
	E-mail program	Mozilla-Thunderbird	MIME IMAP POP	
	Agenda and contact manager	Evolution from Ximian	iCal	
	Word processor	Open Office	Oasis Open Office XML Format PDF	.doc is a proprietary format .PDF is an open proprietary format
Infrastructure (basic and advanced applications)	E-mail server	Sendmail, Cyrus	SMTP, IMAP	Exchange is proprietary.
	Agenda and contact manager server	OpenGroupware	iCalendar	
	Web server	Apache	HTTP V1.1	The most widespread on the Internet
	Identity server	OpenLDAP	LDAP	
	Token server	MIT Kerberos server	Kerberos	
	Single-sign-on server (SSO)	Common authentication services	Based on Kerberos	
	Federated identity	SourceID	SAML	
	Database server	MySQL, PostgreSQL Ingres And many others	SQL 93	

Table 1: Functionality, open source software and standards

Here is yet another example of the synergy between standards and open source software from OASIS. All these emergent standards have at least one open source reference implementation available.

- Asynchronous Service Access Protocol (ASAP)
- Content Assembly Mechanism (CAM)
- Docbook
- ebXML Collaboration Protocol Profile & Agreement (CPPA)
- ebXML Messaging Services
- ebXML Registry/Repository
- eXtensible Access Control Markup Language (XACML)
- Open Office XML Format
- RelaxNG Schema
- UDDI Specification
- Web Services for Remote Portlets (WSRP)
- Web Services Security (WSS)

These two lists are far from comprehensive. Others have conducted exhaustive surveys of open source software and of the criteria for their acceptance by organizations. Nonetheless, we feel that it is necessary to create better characterizations of open source software, of the standards they support, and mostly of the interoperability profiles they support.

5. Conclusions and recommendations

This study is short and, unfortunately, was written under time constraints. Nonetheless, we can identify several conclusions:

- Interoperability among the Government of Québec's systems is a necessary condition for accomplishing the goals of online government, controlling costs in certain sectors (such as health), and providing new services to citizens.

- An interoperability framework is required to meet this target.

- In keeping with other governments, such as the European Community, the Government of Québec must base its interoperability framework on open *de jure* and *de facto* standards.

We recommend that the Government of Québec:

- Pursue its work elaborating an interoperability framework for its computer systems that is based on open *de jure* and *de facto* standards. This framework should not only reflect the criteria enumerated in this study and cover internal computer systems, but it should also extend to Web services offered to organizations outside of the government. The interoperability framework should initially draw on that of the State of Massachusetts. In the medium term, is should be as comprehensive as that of the British Government.

- Integrate this interoperability framework into its enterprise architecture.

- Publish this interoperability framework with its enterprise architecture.

- Specify this interoperability framework in its calls for tenders.

- Elaborate a policy of compliance with this framework for all new applications.

Within compliance policies, it must explore means to:

- Mandate one or several agencies to identify one or several existing compliance tests and activities, prioritizing usage scenarios and recurring needs relevant to governments. This agency would first seek to reuse pre-existing compliance tests that are freely and openly available, and then to develop its own in collaboration with partners, when necessary.

- Validate the compliance of all new computer applications with this interoperability framework.

6. References and notes

[1] Government of Québec benchmark for information resources, Shared interoperability framework, Version 1.2, January 15, 2005.

[2] "Interoperability and practice", March 30, 2004, Irish Government, http://sdec.reach.ie/rigs/rig0012.

[3] Bilan du choix du logiciel libre au sein de l'Administration Fiscale, cf. http://www.solutionslinux.fr/document_conferencier/420c7d626d898.pdf.

[4] http://definition.futura-sciences.com/I/interopeacrabiliteac.html

[5] http://www.aits.ca/Presentation/Fev1/Andrew_Grant.pdf (this link appears to be dead)

[6] http://www-106.ibm.com/developerworks/patterns/library

[7] Tworek, Bill, "Patterns: Portal composite pattern", http://www-106.ibm.com/developerworks/patterns/library/w18.pdf.

[8] http://www.stsc.hill.af.mil/crosstalk/2003/02/Coallier.html

[9] http://www.webopedia.com/TERM/C/CDMA.html

[10] http://en.wikipedia.org/wiki/ABAP

[11] http://www.wi-fi.org/OpenSection/index.asp

[12] http://www.etsi.org/forawatch/home.htm

[13] http://www.oasis-open.org/presentations/ws_forum_conceptual_model.ppt

[14] http://www.webopedia.com/quick_ref/OSI_Layers.asp

[15] http://www.oasis-open.org/committees/tc_cat.php?cat=lawgov

[16] http://www.oasis-open.org/committees/tc_cat.php?cat=schain

[17] http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=ihc

[18] http://www.ws-i.org/

[19] http://unpan1.un.org/intradoc/groups/public/documents/APCITY/UNPAN007465.pdf

[20] Oriolas, Juliette Campos, Le cadre commun d'interopérabilité des services d'informations publics, http://www.adae.gouv.fr/upload/documents/Italiens.pdf.

[21] http://www.windley.com/archives/2003/09/egovernment_int.shtml

[22] http://www.govtalk.gov.uk/documents/e-GIF-v6_1.doc

[23] http://www.govtalk.gov.uk/policydocs/policydocs_document.asp?docnum=905

[24]http://www.mass.gov/portal/index.jsp?pageID=itdterminal&L=3&L0=Home&L1=Policies%2c+Standards+%26+Legal&L2=Open+Standards&sid=Aitd&b=terminalcontent&f=_policies_standards_open_standards_policy&csid=Aitd

[25]http://www.mass.gov/portal/index.jsp?pageID=itdsubtopic&L=3&L0=Home&L1=Policies%2c+Standards+%26+Legal&L2=Drafts+for+Review&sid=Aitd

[26] http://www.govtalk.gov.uk/schemasstandards/metadata.asp, http://www.govtalk.gov.uk/schemasstandards/gcl.asp

[27] http://www.govtalk.gov.uk/schemasstandards/datastandards.asp
http://www.govtalk.gov.uk/schemasstandards/xmlschema.asp