Interoperability issues for E-Governance Framework

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Abstract. **Interoperability has been identified as a major issue to be addressed by all e-government agencies. In the first stage of this awareness, interoperability deals with applications and semantics concepts, which will enable the seamless information flow between organizations? However, it will not be enough for enabling the sort of interoperability required for a true seamless service delivery to citizens and business, which is the vision of the e-government strategies. A second stage in interoperability shows up which deals with the building of an enterprise architecture. The paper highlights the critical role of interoperability and investigates the way it can be incorporated into e-government domain in order to provide efficient and effective e-services. It also describes issues-steps associated to interoperability, depicts the arisen technical dimensions, proposes solutions when possible, and discusses its effectiveness.**

Key words: **ICTs; e-government; Frameworks; interoperability; XML; web services; SOA; government organizations.**

I. Introduction

The interoperability framework aims at providing the basic standards that all the agencies which are relevant for the e-government strategy implementation should adopt. This interoperability framework will allow, at least, the interoperability between information systems from different agencies in order to provide services to citizens and businesses in an integrated way. E-governance based services are largely routed through government portals that bring in some inherent advantage one which is one stop services to citizens, business and government's own employees. This would mean all these users will be able to access integrated public services through a single point even if these services are actually provided by different departments or authorities. This, however is very demanding proposition since it would require achieving integration of processes, data and technology at the backend. This would also decide the level of e-government maturity. The higher the level of e-government maturity in a country, the easier it would be to achieve a one-stop government portal. Integration and Interoperability (vertical and horizontal) are two vital technical issues of the one-stop portal.

II. Integrating Islands of Applications

Interoperability issues create inconveniences; which increase cost, decrease effectiveness, and blur transparency. E-Governance, the electronic services provided by the public administration, facilitating citizen participation, is no longer a dream or luxury for our country. Our government has taken several initiatives to introduce e-governance. The government has started using ICT services and software wherever it can. Now each ministry/division has its own website. These websites are intended to provide information and services to our citizens and businesses. But the different ministries/divisions don't follow standards while developing their management information systems (MIS), websites, and portals.

- E-Governance Applications are developed independently, as stand-alone

- Applications are tightly coupled to their own sets of data & processes

- Too much data, and not enough information

- Isolated domains of information

- Too expensive to bridge to meet the requirements of Interoperability

Most of the e-governance initiatives so far have created islands of information, difficulties in data interchange, and inefficient communication among the government, the businesses and the citizens. Technology incompatibility is only a piece of this "Interoperability Issues Puzzle" in e-governance initiatives in India. Incompatibilities in government processes, diverse and distributed working groups, people, teams, multiple interest perspectives, and interest groups, all create much larger issues for interoperability than the technology alone. We have hardly noticed any re-usability of elements like

government processes, architectures, designs, and technology components in e-governance applications developed so far.

Interoperability Framework for E-Governance (IFEG) that comprises a set of policies and technical standards to facilitate interaction between isolated E-Governance applications. Leveraging the recent technical advancements that allow applications to interoperate, regardless of the underlying technologies, IFEG envisages facilitating joined-up service delivery through a single window. As an initial step, the implementation of IFEG standards has already begun in certain National Level Projects

Technical Standards & e-Governance Architecture

- ✓ Layered Architecture
- ✓ Open Standards at all the layers.
- ✓ Development based on Open standards.
- ✓ Platform Independence.
- ✓ Reusable Component based development.
- ✓ Policies and guidelines for Application Development

- Standards-based approach in all e-Governance application developments by multiple agencies would ensure interoperability

- Data, meta data and operational specifications will be standardized in order to facilitate real-time management of government activities and services.

- Standards help in ensuring transparency between all kinds of e-governance applications.

III. Technologies for Interoperability

There are various technologies that help in achieving the objectives of the one-stop government portal by solving the problem of interoperability. Key technologies are discussed below:

[A] Service-oriented Architecture (SOA)

SOA is an architectural style whose goal is to achieve loose coupling among interacting software agents. A service is a unit of work done by a service provider to achieve desired end results for a service consumer. Both provider and consumer roles are played by software agents on behalf of their owners. Service Oriented Environment is based on the following key principles:

- ✓ SOA is not just architecture of services seen from a technology perspective, but the policies, practices, and frameworks by which we ensure the right services are provided and consumed.
- ✓ With SOA it is critical to implement processes that ensure that there are at least two different and separate processes—for provider and consumer.
- ✓ Rather than leaving developers to discover individual services and put them into context, the Business Service Bus is instead their starting point that guides them to a coherent set that has been assembled for their domain.

[B] Web Services (WS)

Web service is "a software application identified by an URI, whose interfaces and bindings are capable of being defined, described and discovered as XML artifacts. A web service supports direct interactions with other software agents using XML-based messages exchanged via Internet-based protocols". The encountered problems with development of Web Services are:

- ✓ Its ontology building in itself is time consuming.
- ✓ The dynamic nature of the field. The exponential rise in the number of bioinformatics Web services over the past year required a further two months effort to maintain and extend the ontology.
- ✓ Lack of guidelines on how to build the domain specific ontology, or indeed how to relate it to upper level.
- ✓ Differing interpretation of the myriad of standards – SOAP, WSDL, UDDI, XML Schema etc.; and how they relate

The architecture contains a set of collaborative tools for e-government Web Services that are semantically enriched.

Application Hosting Environment

Database Environment
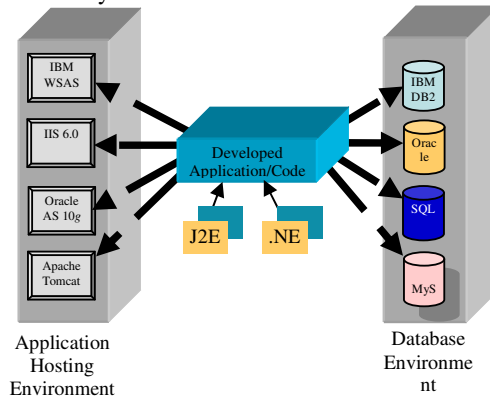
Although SOA and Web Services go a long way towards providing interoperability in distributed,

heterogeneous environments, managing semantic differences in such environments remains a challenge.

## III. Challenges of Interoperability

The key challenges with electronic governance are not technology or internet issues but organizational issues like

- ✓ Redefining rules and procedures
- ✓ Information transparency
- ✓ Legal issues
- ✓ Infrastructure, Skill and awareness
- ✓ Access to right information
- ✓ Interdepartmental collaboration
- ✓ Tendency to resist the change in work culture

Interoperability is essential for achieving one-stop government portal. In order to apply Interoperability to the Government portal the following challenges arise:

[A] Technical interoperability

Technical Interoperability covers the technical issues of computer systems. It includes also issues on platforms and frameworks. Frameworks are complex and many times provide conceptual differences to working approaches; e.g. understanding and relying on classes in an object-oriented system. In addition, at times frameworks are duplicative and contradicting with multiple levels.
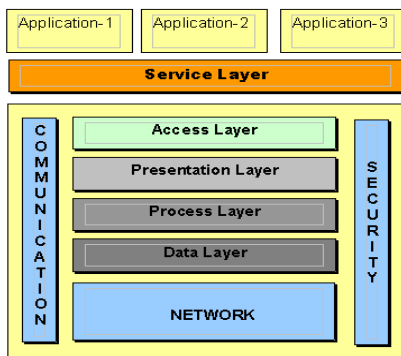
[B] Organizational interoperability

Organizational interoperability is concerned with organizational processes and cooperation of agencies. The processes are not enough flexible and adaptive to be integrated and be interoperable. Here the requirements of decentralized agencies have to meet the central needs on coordination. The top level management plays a vital role. Leadership and strategic direction of management are cited as the most important factors for corporate adoption of Web technology.

[C] Semantic Interoperability

Interoperability or integration efforts are about making information from one system syntactically and semantically accessible to another system. Syntax problems involve format and structure. Semantics being an important technical issue is one that is almost invisible outside technical circles. Semantic interoperability is an enterprise capability derived from the application of special technologies that infer, relate, interpret, and classify the implicit meanings of digital content, which in turn drive business process, enterprise knowledge, business rules and software application interoperability.

In view of its pre-eminence in developing e-governance applications, the foremost thrust of this interoperability framework is to adopt Internet and World Wide Web Standards for all applications for Government systems. This is achieved by evolving a framework that sets standards and specifications for various aspects of ICT systems. Such an Interoperability Framework (IF) will support the E-Governance strategies of providing citizen-centric services by facilitating interoperability of ICT systems between all the stakeholders of E-Governance. In addition to technology, this framework will also address both procedures and content.

IV. Interoperability Framework (GIF).

A well-developed GIF can assist governments in effectively implementing e-government services and can contribute to issues relevant to the achievement of the Millennium Development Goals. Such a GIF can, for instance, help States make better and more informed decisions during times of both crisis and tranquility, effectively preserving electronic public records, incorporating new technologies seamlessly into existing systems, contributing to citizens' access to information, and stimulating competition among computer vendors for low-cost, innovative technologies.

[A] Open standards and its role in e-government interoperability

Open standards, play a key role in achieving interoperability. Open standards enable products to work together. They also lead to diversity of suppliers / vendors and technological development. Open standards also ensure quality. Many believe that open standards should be at the core of standards that governments adopt to achieve e-government interoperability.

[B] STANDARDS AND ARCHITECTURE IN INTEROPERABILITY

Open standards describe openness in both the setting process and access to the specifications. Open standard is usually contrasted with proprietary standard or a standard that is owned and controlled by an individual or a corporation. Following key are the main characteristics of open standards:

Availability: Open standards are available for all to read and implement.

Maximize end-user choice: Open standards create a fair, competitive market for implementations of the standard. They do not lock the customer into a particular vendor or group.

No royalty: Open standards are free for all to implement, with no royalty or fee. Certification of compliance by the standards organization may involve a fee.

No discrimination: Open standards and the organizations that administer them do not favour one implementer over another for any reason other than the technical standards compliance of a vendor's implementation. Certification organizations must provide a path for low- and zero-cost implementations to be validated, but may also provide enhanced certification services.

Extension or subset: Implementations of open standards may be extended or offered in subset form. However, certification organizations may decline to certify subset implementations, and may place requirements upon extensions.

Open standards are also the backbone of a service-based approach to e-government interoperability. They ensure flexibility so that criteria and decisions are service-oriented and technology neutral. Open standards enable managers to combine, mix and match, and replace components without the expense and expertise of custom coding connections between service components.

Are open standards related to open source? Does open source have a role to play in e-government interoperability?

Open standards is not synonymous with open source. The former is a set of specifications, the latter is an implementation. What they share is a commitment to 'openness' – freedom from control by an individual, group or corporation, and equal opportunities for everyone to participate.

Open source software (OSS) as well as free software "are programmes whose licenses give users the freedom to run the program for any purpose, to study and modify the program, and to redistribute

copies of either the original or modified program (without having to pay royalties to previous developers)." According to the Open Source Initiative, "Open source is a development method for software that harnesses the power of distributed peer review and transparency of process. "

These standards selection principles are:

- ✓ Scalability: Standards selected should be able to handle change or fluctuation in demand and volume of transactions.
- ✓ Security and privacy: Standards selected should be in accordance to an existing security policy including user data protection.
- ✓ Market support: Standards selection gives preference to standards with wide market support to reduce costs and risks to government systems.
- ✓ Preference to established national or international standards:
- ✓ Standards selection gives preference to existing international standards with the broadest remit.

V. GOVERNMENT INTEROPERABILITY FRAMEWORK

Organizational interoperability is "concerned with the coordination and alignment of business processes and information architectures that span both intra- and inter-organizational boundaries." It aims to bring about "the collaboration of administrations that wish to exchange information and may have different internal structures and processes.

Technical interoperability, itself, has several layers or categories.

There are at least four layers:

- ✓ Interconnection: Covers standards related to networks and system development. This layer enables communications between systems.
- ✓ Data integration: Contains standards for the description of data that enables exchange between disparate systems.
- ✓ Information access and presentation: Refers to the presentation of data to the user in the various means of access to e-government services.
- ✓ Content management and metadata: Pertains to the standards for retrieving and managing government information.

The security layer contains standards that ensure safe access and exchange of information in public

services. Some GIFs focus on improving standards for business services. These standards are meant to support data exchange, particularly in business areas like e-learning, e-health, etc. Another extension to the layers are categories of standards for web-based services. These standards connect and integrate web-based applications over the Internet.

[A] Interoperable information System

Developing interoperable information System consists of two sets of standards – one for data and other for metadata.

Data Standard

Achieving data coherence across government means that government organizations need data schemas that have been agreed upon for use throughout the government. Since development of information systems has evolved in a largely decentralized manner, government databases may not be compatible, thus inhibiting data sharing and fostering duplication. The Government Data Standards Catalogue is a data dictionary to be operated across Government that holds information about data items widely used across Government.

Metadata Standard

The most common definition of metadata is 'data about data'. A more helpful definition is that it is structured information about a resource - a summary of the form and content of a resource. Among other benefits, the use of metadata facilitates achieving interoperability. Metadata standards provide a way for information resources in electronic form to communicate their existence and their nature to other electronic applications (e.g. via HTML or XML) or search tools and to permit exchange of information between applications

VI. Proposed Framework for Interoperability

The approach towards interoperability should be based on the following premises:

1. Browser based interface for access
2. XML as the primary means for data integration
3. Acceptance of Internet and World Wide Web standards
4. Metadata Standards for content management

The interoperability framework should be based around a hierarchy of standards ensuring that international standards are used where ever possible, national standards could be used to cover items specific to the country, and new standards are developed where none exists. A minimum set of standards that are relevant for system interconnectivity and information exchange should be selected.

These standards should be open in the sense that they are publicly available and well documented. Moreover, standards having wide market support should be chosen to reduce cost and risk. Some of the crucial areas of technical interoperability where policies and standards would be required are – Networking, Interconnection, e-mail, Directory Service, Domain Name Service, File Transfer Protocol, Security etc. There are a number of well-established international standards in these areas.

A common approach to attain interoperability is aligning the government information system with the Internet and adopting the standards available for the Internet. Choice of standard browser with required plug-ins for accessing government information systems as a part of the technical framework also makes life easier. But we need to remember that choice of browser for accessing information may restrict choice of technology for developing information systems. Some of the policies related to technical interoperability are:

- ✓ Networking would be IPv4 based, and IPv6 in due course
- ✓ e-mail clients have to conform to SMTP/ MIME for message transport and POP3 for mailbox retrieval.
- ✓ LDAP V3 is to be used for general-purpose directory access
- ✓ DNS is to be used for Internet/intranet domain name to IP address resolution
- ✓ Application has to be Web based whenever possible. Web based services are to be based on SOAP, UDDI and WSDL
- ✓ FTP should be used where file transfer is necessary within government intranets. Restart and recovery facilities of FTP are to be used when transferring very large files

VII. e-Governance Architecture

[A] Reusability

A large number of E-Governance applications developed in isolation, resulted in self-contained islands of information. Every application followed its own standards with the main objective of delivering process-centric results irrespective of other applications. Hence, at the outset there is a need for an architecture that is aimed at reuse and customization. Software reuse must become a key part in the software architecture. Systematic techniques for reuse adoption must therefore be enabled.
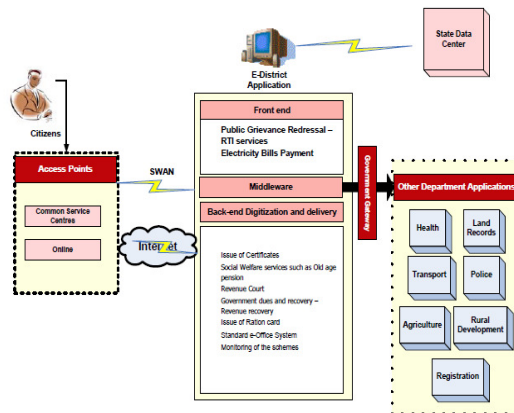
[B] Middleware and technology standards

There is a need to introduce the concept of middleware and technology standards as a tool to develop integrable, scalable and robust E-Governance solutions, while employing multiple solution providers. The middleware should support processes involving multi-department and multi-agency workflows. For this purpose, it is necessary that the different department offices and also external agencies are interconnected and share the same underlying back-end databases and applications. The middleware also should be able to facilitate integration with legacy systems.

Middleware needs to provide services such as identification, authentication, authorization, directories, and security to all applications. By promoting standardization and interoperability, middleware will make advanced network applications much easier to use.

The key middleware components are (a) Web Application Server, b)Inter-application communication and messaging and collaboration software (c) Language and data interchange standards.

[C] Service-Oriented Solutions

Applications must be developed as independent sets of interacting services offering well-defined interfaces to their potential users.

VIII. e-Governance Standards Compliance Projects

[A] Architecture and Technology Issues

- ✓ Open Architecture - Platform Independence - a reusable architecture framework which can be quickly deployed
- ✓ Security - Support for HTTPS - Secure Socket Layers (SSL) 128 Bits.

- ✓ Accessibility Compliant - WAI-AA (Web Accessibility Initiative – Priority level AA)
- ✓ Open Formats: used for archival to ensure that information can beϖ retrieved at any point of time without any information loss

- ✓ iCALender format for Calendar to provide interoperability and coexistence between different scheduling systems;
- ✓ XHTML and CSS (Cascading Style Sheets) Standards compliant
- ✓ SMS Integration
- ✓ Site Protocol Standard for Search
- ✓ LDAP Server Integration for Single Sign On

[B] Localisation and Language Issues

- · Adoption of uniform Encoding Standards for Indian Languages

- · Support for Inputting Mechanisms

- · Web Site in Regional Languages

- · Standards for encoding and machine translation

- · Multi-lingual support to be ensured across platforms and applications

[C] Areas for E-Gov Standards

1. Procedure for Standards Formulation
2. Quality Manual
3. Conformity Assessment Framework
4. Electronic Records Management
5. Preparation of Request For Proposal
6. Service Level Agreement
7. e-Governance Project Life Cycle
8. e-Governance Projects Management
9. Methodology for identification of best possible solutions
10. Outsourcing Management
11. Capacity Building for e-Governance
12. e-Waste Management

IX Conclusions

Many of the current e-Governance applications in India are in the second stage of evolution. To reach the 'transformation' stage, interoperability has to be achieved at both the technical and semantic level. The required framework for interoperability can be achieved through alignment and adoption of common standards with the Internet, and WWW for all government information systems; adoption of XML as the primary standard for data integration and presentation, and Browser as the key interface.

Successful implementation would require making available best practice guidance, toolkits, schema development guidelines and centrally agreed data schemas.

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