Introduction

E-governance is the use of modern information and communication technologies such as internet, local area network, wide area network, mobiles, etc., by government to improve effectiveness, efficiency, and service delivery to citizens and promote transparency [1-5]. By implementing an e-governance initiative government departments will streamline their processes, connect all the stakeholders, cut costs, and improve the delivery of their services.

Implementing e-governance projects aims at achieving several objectives and goals that adhere to the following principles:

- Improvement and enhancement delivery of government services
- Empowerment of citizens through greater access to government information and ability to interact and participate
- Transparency achievement and higher accountability of the government
- Improvement of internal relationship between the government and the citizens’ electronic delivery

E-governance provides the common framework and direction in the implementation of government policies for the following:

- Government Sectors (G2G)
- Government and Business (G2B)
- Government and Citizen (G2C)

Challenges in E-Governance

Several challenges and issues that need to be addressed to meet the goal of effective e-governance are

**Business Challenges**

- Information sharing
- Lack of real-time visibility of approval workflows for better transparency
- Lengthy processes for legal framework to support e-governance
- Insufficient telecom infrastructure to support e-governance
- Unaffordable internet services for private sector and citizens
- Limited ICT human capacity to support e-governance

**Technical Challenges**

- No service centricity, data duplication, and redundancy
- Ability to search and retrieve the information in a seamless manner from anywhere at any time
- Integrating desperate business applications into common workflow
- Security enforcement
- Lack of integration between systems within and across departments leading to manual overhead, lower productivity, and potential revenue leakages and losses
- E-forms
  - Government paper-based forms remain the primary data gathering interface. They are manually intensive and expensive to process. Rigid, logistical burdens
of manual, paper-based forms add hidden costs and time delays to critical business information flows
  o Government officials to handle large volume of forms and respond to request in timely manner
  • Managing IT complexity and changing requirements
  • Change management
  • Bandwidth constraints

The Goal of E-Governance is
To enable citizens and private/public sectors to access government services in effective and efficient integrated services delivery to the customers anywhere, any time in a form convenient to the service recipients through the use of internet and other channels like mobile phones, etc. It also enables citizen to participate in the government’s policies framing and decision making.

Preliminary analyses indicate the need to redesign the basic processes and to use the Service Oriented Architecture (SOA) and the web services for optimizing the performance of e-governance applications. This can be achieved by enhancing the agility and flexibility of the technologies used in e-governance applications.

This paper attempts to find an approach to implement/enhance e-governance using SOA as the solution approach.

Service Oriented E-Governance
The main objective of e-governance is to allow the public sector to provide citizens with information based on their need, hence increasing their effectiveness, efficiency, and quality of service.

An SOA approach to e-governance aligns IT with service delivery goals and enables various government departments to re-use developed assets. The goal is to provide a flexible SOA solution for governing, integrating, deploying, securing, and managing services, irrespective of the platforms on which they were created.

A Service Oriented E-governance (SOE) based solution needs to rapidly transform existing applications, data, and content into web services using a completely non intrusive approach that requires no changes to the existing applications.

An SOA based solution reduces the dependency on back-end applications and the need to write code every time there is a change in policy, and introduces new software that promotes the direct collaboration of citizens and government departments irrespective of the delivery model.

The various steps involved in executing SOE are (1) service identification, (2) identification of forms, (3) business process modeling/re-engineering, (4) services solution architecture, (5) integrating various departments, (6) deployment (centralized or decentralized).

The following diagram depicts the activities associated with each step for executing complete SOE.
Service Identification

The process for prioritizing e-services is an iterative pattern, guided by both transaction criteria and the perceptions of stakeholders. The methodology for prioritizing the services is expected to provide an impartial view of priorities, drawing on best practices in rationalizing, phasing, and sequencing investments to capture local knowledge and initial conditions, and gather information from secondary source (authorities) to identify key services and stakeholders and the services.

Following are the various categories of the services to be identified:

- Government to Citizen Services (G2C Services)
- Government to Business Services (G2B Services)
- Government to Employee services (G2E Services)
- Government to Government Services (G2G Services)
- Shared services
- Informational services
- Interactive services
- Transactional services
- Integrated services

**Government to Citizen Services**

G2C services will include providing information and facilitating transitions such as electronically paying bills, making appointments, and renewing licenses. G2C is about giving citizens the convenience of choosing when and where they access public services. It is about changing the way people view the government. And it is about being transparent and efficient rather than bureaucratic.

**Government to Business Services**

G2B services could include providing information, such as industry standards and supplier directories and ratings, and conducting transactions, such as electronic quotations and company registrations.
G2B is about making interactions, transactions, and communication faster, clearer, and easier for business.

**Government to Employee services**

G2E services or transactions between employees and their ministry or agency could include information management [intranets], knowledge management [content management systems], and collaborative and communication management [e-mail, messaging systems].

**Government to Government Services**

G2G services or transactions between ministries or agencies could include the provision of central services and information.

**Shared Services**

To provide reliable and efficient e-services, any government agency will typically need to provide customer support, collect payment online, and authenticate the users.

Customer service is a capability that will be needed for all e-services, to guide and support users.

**Informational Services**

These include general information, supplied to the client in the form of instructions, information required by the user in the normal course of life, and information that pertains to the individual user and is likely to be private.

**Interactive Services**

These services are more sophisticated, formal interactions between citizens and government in which communication is conducted through email, online feedback, and the like. Interactive services also include the ability to search for records, to download forms and applications, or to submit them.

**Transactional Services**

A government can provide a wide array of services through online transactions, such as enabling users to apply for housing, pay traffic fines, or apply for permits. It is at this stage that e-government becomes functionally interactive and therefore especially useful to the public.

**Integrated Services**

With integration, services become seamless and client focused. Government services are clustered along common needs and linked for ease of use.

**Identification of E-forms**

E-forms help the government departments to maintain a structured and streamlined process. Also, with e-forms, government departments process forms more efficiently, timely, and securely, helping achieve cost savings and meeting the demands of an online department.

Identify types of e-forms:

- Information gathering forms
- Transaction processing forms
- Regulatory compliance forms

Specify the structure (metadata) of e-forms – name, data type, length, context, etc.

Constructing electronic forms from metadata promotes the reuse of metadata across forms, which in turn reduces form authoring costs, and facilitates harmonization across forms.

The e-governance initiatives within the government employ XML as a core technology to enable data interoperability, exchange, and reuse.
Business Process Redesign

Business Process Redesign in e-governance involves critical analysis and thorough redesign of workflows and processes within and between government departments. It helps in improving the performance of the process. Business Process Re-engineering ensures that processes are redesigned to ensure effectiveness, thereby delivering the maximum value to the government, its employees, and the common citizen.

The main stages in BPR methodology are

- Map existing processes
- Define end-state
- Gap analysis
- Redesign of workflow and processes

Adoption of BPR in e-governance helps to

- Lower cost
- Increase revenue
- Enhance effectiveness, efficiency, and re-usability
- Increase customer satisfaction

Services Solution Architecture

The following are the important features of the E-Governance Portal and Middleware solution:

- Adopt Service Oriented Architecture
- Develop business functionality as services
- Provide web based interface
- Extensible to support multiple access devices such as desktop computer, IVRS, mobiles, CSCs, etc.
- Ensure confidentiality of citizen’s data
- Achieve interoperability between state portals and national portal.
- Integrate with departmental applications for services
- Integrate with websites of government departments and organization for content

E-Governance Portal allows the citizens to access government information easily and to enjoy one-stop government services. It enhances the customer focused service delivery channels. E-Governance Portal allows a department to present information, applications, and services in a single consolidated browser view. It provides a secure and individualized view of multiple online resources and interactive services. It offers a single access point to critical information and the primary applications necessary for an individual to avail the services. In a simple way, E-Governance Portal acts like an interface between the government and the citizens.

The following diagram depicts the contextual view of the E-Governance Portal.
E-Governance Portal is built based on Service Oriented Architecture (SOA). Service Oriented Architecture (SOA) may be defined as a group of services that communicate with each other through data-passing or two or more services coordinating some activity. SOA builds applications out of web / software services. Services comprise un-associated units of functionality that have no calls to each other embedded in them. They typically implement functionality most citizens would recognize as a service, such as filling out an online application for a driver’s license, viewing an online electronic form, or submitting a grievance or query. To meet an existing or new business requirement, services are linked and sequenced in a process known as orchestration. Web services make these functional building blocks accessible over standard internet protocols independent of platforms and programming languages. These services can be new applications or just wrapped around existing legacy systems to make them network-enabled.

Usage of Extensible Markup Language (XML) aids various department portals in sharing structured data, especially via the internet, to encode documents, and to serialize data.

The departments that are to be integrated with the E-Governance Portal need to interact with the portal and to each other for seamless delivery of information / services to citizens. The interactions between these departments are proposed to be done using industry’s widely accepted and adopted Service Oriented Architecture (SOA) framework. The interoperability is built by using Middleware on XML (eXtensible Markup Language) and web services standards.

Using SOA framework, the services at E-Governance Portal would be exposed using the web services, and some can be consumed by various departments on demand basis. All the services will be realized by the technology platform, which has the following architectural building blocks:

- Web server
- Application server
- Middleware
- Directory server
- SMTP server
Client Layer

Citizens, CSCs, and government are the stakeholders of the E-Governance Portal solution that forms the client layer. The client layer constitutes the web client, which is normally the web browser. The stakeholders can receive the information/deliverables by the services through channel delivery services.

Figure 3. Solution Architecture of E-Governance Portal
Desktop, IVRS, and CSC users directly access the E-Governance Portal through internet over HTTP/HTTPS protocol. Requests from mobile users will be processed using mobile switch, which, in turn, forwards requests to WAP gateway where WML will translate into HTML that will forward to E-Governance Portal web server.

**Channel Delivery Layer**

Channel delivery services contain the secured gateway services, which handle the number of transactions across the entire network. The various secured gateways that are used are XML gateway, SMS gateway, SMTP gateway, Web gateway, etc.

**Presentation Layer**

Presentation services handle the user management, personalization features. Based on the type of user logged in, the layer routes the request to the respective services of the business service layer of the E-Governance Portal solution.

**Web**

The Web Portal provides information for the stakeholders over internet using a web browser. There will be certain sections of the portal which will be accessible to all the users, which is referred to as the “public” part of the E-Governance Portal and certain sections which can be accessed only by authorized users referred to as the “protected” part of the portal. The E-Governance Portal solution would support multi-lingual content, and pages will be displayed in the language selected by user.

**Personalization**

Personalization component provides stakeholders to customize their preferences for better user experience. Personalization covers the ability for a user to influence their experiences.

**Security Layer**

The secure proxy server intercepts stakeholders whenever they request to access the secured information. URL will be routed to this component where it will challenge (User Id and Password) the user for authentication if user accesses the secured information.

**Business Logic Layer**

**Business Services**

The business services will provide required services for its stakeholders. These services will be provided by government and various applications and consumed by government departments using service communication components.

**User Management**

The user management function addresses how identities and users are created, maintained, or revoked on termination.

**Self-Service**

Self-Service component will provide interface to citizens to manage their own profile information, such as user registration, reset passwords, update contact information, and request for accessing government services, if required, etc.

**Content Management Services**

Portal solution has a large number of content objects and documents. It manages the complete lifecycle of all content objects. Content generators create information that is stored and managed in electronic or manual record form.
Workflow Services
Workflow services capture input data, standard processes, and business rules for processing data for a pre-defined output. Workflow service addresses the application submission, status tracking, and verification of documents, and availability of service.

Search
The E-Governance Portal solution will have a search component to provide quick access to information, including documents, HTML pages, images, audio files, video files, etc.

Notifications
The E-Governance Portal will have the facility to send notifications – alerts to its registered users. Users should be able to subscribe for some of the services like SMS, News, etc. For updates in these services, subscribed users of Portal will get notifications by email.

Infrastructure Services Layer
The E-Governance Portal would contain the following list of utility services to maintain and manage the E-Governance Portal application.

- Application logging
- Exception handling
- Notifications

Data Layer

Database Server
E-Governance Portal application will use Relational Database Management System (RDBMS) for persistent store of structured data.

Document Repository
Static content of E-Governance Portal such as documents, PDF files, images, audio/video files, etc., would be stored in document repository. These files should not be stored in database.

Directory Server
The directory server of E-Governance Portal contains profile information of stakeholders, roles, application level ACLs (Access Control Lists), service level access control list, etc. This directory server should be made accessible using LDAP.

Integration Layer

Service Communication Infrastructure
Middleware as a messaging acts as an intelligent hub and routes service requests from a service seeker (service access provider) to a service provider (typically a back end government department that puts up its service for electronic delivery) and in return sends the response back to the service seeker through the gateway.

The gateway achieves integration among diverse set of applications built on varying platforms based on open standards such as the W3C XML and SOAP specifications.

Management and Monitoring Layer

Application / Network / Infrastructure Management
Infrastructure components of E-Governance Portal will manage and monitor the health of the application, network, hardware, software, etc., to manage standard architectural requirements. Following are list of components that should be monitored:

- CPU usage
- Hard disk usage
Integration to Various Departments

Integration strategy in e-governance is very critical as most of the departments might have built their own application and run in silo form. These departments need to be integrated to the E-Governance Portal to achieve better citizen service.

The E-Governance Portal works as a single source of information for all government content, and provides front end or start point for all the government services provided by the various government departments. The functionality of departmental applications and services provided by the departments is made accessible on E-Governance Portal as services using web services technologies. Web service based implementation of transactional government services will make them reusable, easy to integrate, interoperable and easily accessible.

The following diagram summarizes the various integration approaches to be adopted for integration to E-Governance Portal services.

![Figure 4. Integration Approaches](image)

Centralized Versus De-Centralized Architecture

Centralized architecture standardizes the IT services across the government departments. It provides the services that span across various departments with a centralized resource allocation mechanism. Centralized model maximizes the benefits from investment and helps greater integration across various departments and the E-Governance Portal.

Specific benefits include

- Governance team can concentrate on their core business applications and revenue generation, and better citizen services models
- One-time investment in a unified infrastructure
- Centralized control
- Unified business model among all departments
- Integrated workflow across government departments
- Reduced duplication of effort, resources, and expertise
De-centralized architecture is preferred when government agencies conduct separate implementations of different business processes across individual departments.

Specific benefits include

- Easier integration with core business applications within the government departments
- Various departments already have their own systems and are happy with their solutions.
- Lower dependency: Government agencies prefer a highly autonomous approach.
- Flexibility for customization to meet department specific needs
- Startup costs are relatively low (considering departments current investments).
- Risk of an entire system breakdown vanishes (compared with centralized)

Conclusions

Service Oriented Architecture for e-governance provides the transparent governance to citizens by IT enabling various government departments. Usage of SOA and web services optimizes the performance of government applications. The Service Oriented E-Governance based solution transforms the existing applications, data, and content into web services without reengineering the applications.

The steps to be considering in successfully executing Service Oriented E-Governance are

- Service identification
- Identification of forms
- Business process re-engineering
- Service solution architecture
- Integration to various government departments
- Deployment (centralized/de-centralized)

Using SOE, we can automate the departmental process workflows with support for multistage approval, using standard web based workflow as well as building workflows using Email/SMS/IVRS. A solution based on SOE is highly scalable, which supports high availability, failover, and load balancing features of e-governance applications. It helps in providing the improvement in overall quality of service to citizens by increasing responsiveness, productivity, accountability, and transparency.

In Summary, government can use SOA for

- Data management
- Workflow management and automating business processes
- Service consolidation by making existing in-house legacy systems accessible through a single E-Governance Portal
- Constituent services integration via a single interface for all types of constituent communication
- Improving external partner relationships with a shared library of web services components
- Cost efficiencies by integrating operations and eliminating redundant systems reducing IT automation project timelines
- Application consolidation, re-use, and alignment; and data sharing among loosely coupled networks
References


Glossary of Terms

<table>
<thead>
<tr>
<th>Acronym/Abbreviation</th>
<th>Definition</th>
</tr>
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<tbody>
<tr>
<td>BPM</td>
<td>Business Process Management</td>
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<td>CSC</td>
<td>Common Service Center</td>
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<td>ECM</td>
<td>Enterprise Content Management</td>
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<td>ERP</td>
<td>Enterprise Resource Planning</td>
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<td>ETL</td>
<td>Extract, Transform, Load</td>
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<td>ESB</td>
<td>Enterprise Service Bus</td>
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<td>HTTP</td>
<td>Hypertext Transfer Protocol</td>
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<td>HTTPS</td>
<td>Hypertext Transfer Protocol Secure</td>
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<tr>
<td>HTML</td>
<td>Hypertext Mark-up Language</td>
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<td>IT</td>
<td>Information Technology</td>
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<td>QOS</td>
<td>Quality of Service</td>
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<td>ROI</td>
<td>Return on Investment</td>
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<td>SMS</td>
<td>Short Message Service</td>
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<td>SMTP</td>
<td>Simple Mail Transfer Protocol</td>
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<tr>
<td>SOA</td>
<td>Service Oriented Architecture</td>
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<td>SOE</td>
<td>Service Oriented E-Governance</td>
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<td>SOAP</td>
<td>Simple Object Access Protocol</td>
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<tr>
<td>UDDI</td>
<td>Universal Description, Discovery and Integration</td>
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<td>URL</td>
<td>Uniform Resource Locator</td>
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<td>WAP</td>
<td>Wireless Application Protocol</td>
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<td>XML</td>
<td>Extensible Markup Language</td>
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