

Information Access Initiatives and Rural India

(In Two Volumes)

Vol. II

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Bhai Gurdas Library (Central Library),
Guru Nanak Dev University, Amritsar (Pb.)

SHREE PUBLISHERS & DISTRIBUTORS

NEW DELHI-110 002

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Edition : 2010

Published by :

SHREE PUBLISHERS & DISTRIBUTORS

22/4735, Ansari Road, Darya Ganj,

New Delhi-110 002

✓ ISBN : 978-81-8329-368-6

Printed by :

Tarun Offset

Delhi-110 053

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A Semantic Web Service Based Middleware for E-Governance

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Abstract

Due to lack of collaborative work, resource sharing, operation integration, and incomplete automation of governmental services, the present E-government is facing the problem to cater their services to the citizen in a single web based system. Semantic Web Services (SWS) based Middleware in E-Governance can allow the automated web service discovery, selection, execution making the automatic composition of governmental services a reality. In this paper, we propose a design & architecture of a flexible, expandable and easy to use service oriented Middleware in E-Government to make a WSDL based Web services from a legacy database system. In addition to that, we also illustrated how the semantic web services can extend the e-government services in terms of web service selection, discovery, and automatic composition of the web services. We propose a logical view of the System Architecture for the Interaction between the Citizen and the SWS based Middleware in E-Governance for workflow of the services in portal based e-government. We illustrated a use case

scenario in the context of livelihood development of a country like India using the SWS based middleware in E-governance. Open challenges & issues regarding the middleware have also been discussed.

Keyword: E-Government, Interoperability, Web Services, Semantic Web Services, Domain Ontology, IRS 'II, Service-Oriented Access Protocol (SOAP), Middleware.

E-Governance is the application of information and communication technology (ICT) to achieve efficiency, effectiveness, transparency and accountability of information and transactional exchanges between government to government (G2G), government to employee (G2E), government to citizen (G2C) and government to business (G2B). E-government enables citizens, customer civil servants and members of the public and private sectors to take advantage of automated administration processes accessible on-line. The present E-Governance is suffering from lack of interoperability, resource sharing, operation integration and concept of collaborative work. As a result, a citizen has to wait for a long time to fulfill particular requirements from the present E-government system. In addition to that, the electronic transaction of information as it is at present is a time consuming and tiring process. On the other hand the data standards of the E-government are not adequate and comprehensive. Legacy system can be exposed as web services. Web Services are software modules that describe a collection of operations that can be network-accessible through standardized XML messaging [1]. Web services are modular, self-describing, self contained applications that are accessible over the Internet [2]. The emerging concept of *Web services* is slated to be the backbone of tomorrow's Web. A Semantic Web Service (SWS) is the combination of semantic web technology and web services. Semantic Web Services (SWS) technology [3], [4] provides an infrastructure in which new services can be added, discovered and composed continually, and the organization processes automatically updated to reflect new forms of cooperation [5]. E-Government is an ideal test bed for Semantic Web research due to the heterogeneity of information space with

the challenge to achieve interoperability and process integration. The rest of the paper is organized as follows: Section 2 introduces the motivation for SWS based middleware in E-Governance; section 3 describes the Conceptual Model of SWS based Middleware for workflow of the services in E-Government which is based on semantic web service technologies. Section 4 illustrated some requirements for the middleware in e-governance. Section 5 described a logical view of system architecture of SWS based Middleware in E-Governance Section 6 illustrated the functionality of the Middleware. Section 6 illustrated the applicability of the said architecture in rural areas. Conclusion and future work discussed in section 7.

Motivating the need for SWS based Middleware in E-Governance

The SWS technology solves the semantics problems of Middleware in present E-government system. There are several types of problems in e-Governance; like i) interoperability & service integration in e-government web information system ii) semantics differences related to the scattered ,heterogeneous data .iii)lack of sharing & re-use of data iv)lack of knowledge base system in the middleware. The ability to aggregate and reuse diverse information resources relevant to a given situation in a cost-effective way and to make this available as a basis for transparent interaction between community partner organizations and individual citizen, is a key benefit that SWS technology can provide to E-Government SWS technologies can be an ideal platform to achieve the vision of a knowledge-based, user-centric, distributed, interoperable, and networked E-Government. The use of SWS technologies in Middleware of e-governance promises the following advantages: i) reduction of cost & risk ii) providing better services to the e-government community such as stakeholders, administrations, end users. iii) semantic data integrator iv) semantic service discovery and choreography i.e. re-use of existing services and the dynamic automation of process v) precise and concept aware search using knowledge representations (KR) across multiple knowledge sources vi) virtual consultant such as understanding

customers goals and offering products and services which can help them meet those goals viii) aggregating services on the basis of user preferences ix) better support Graphical User Interface (GUI) by allowing one-stop, customer focused, and multiple viewpoint access to services and shared information in the user interface layer as proposed in Fig-II.

A Conceptual Model of SWS based Middleware for Workflow of the E-Services in E-Governance

We proposed here the conceptual architecture of the SWS based Middleware for developing the e-governance infrastructure as well as the interoperability, integration of the web services. From the point of theory the SWS based Middleware makes the semantic content of web services more clear and perfect and enables computers to understand more accurately. Distributed information or service with different description format can be processed more automatically with the assistance of SOAP, WSDL [6], and UDDI. We describe in detail all the components of the following Middleware. The **IRS-III framework** [6] has been used to automate discovery, composition, and execution of web services. It is based on a distributed architecture consists of three components, **IRS-III Server**, **IRS-III Publisher** and the **IRS-III Client** which communicates through the SOA based protocol SOAP (Simple Object Access Protocol). The server handles ontology management and the execution of knowledge models defined for WSMO. The server receives SOAP requests (through the API) from client application for creating and editing WSMO descriptions of goals, web services and mediators as well as goal-based invocation. The IRS Publisher links Web services to semantic. IRS-III resolve the interoperability and integration between service requestor and service providers using the Web Service Modeling Ontology (WSMO)[7] descriptions within the IRS-III server and provides handlers to invoke services in a specific language or platform (Web Services WSDL, Lisp code, Java Code). After transferring legacy system to web services are stored in UDDI service registry module in WSDL form and DAML-S. In our proposed middleware we have used UDDI [8] service Registry although IRS-III have its

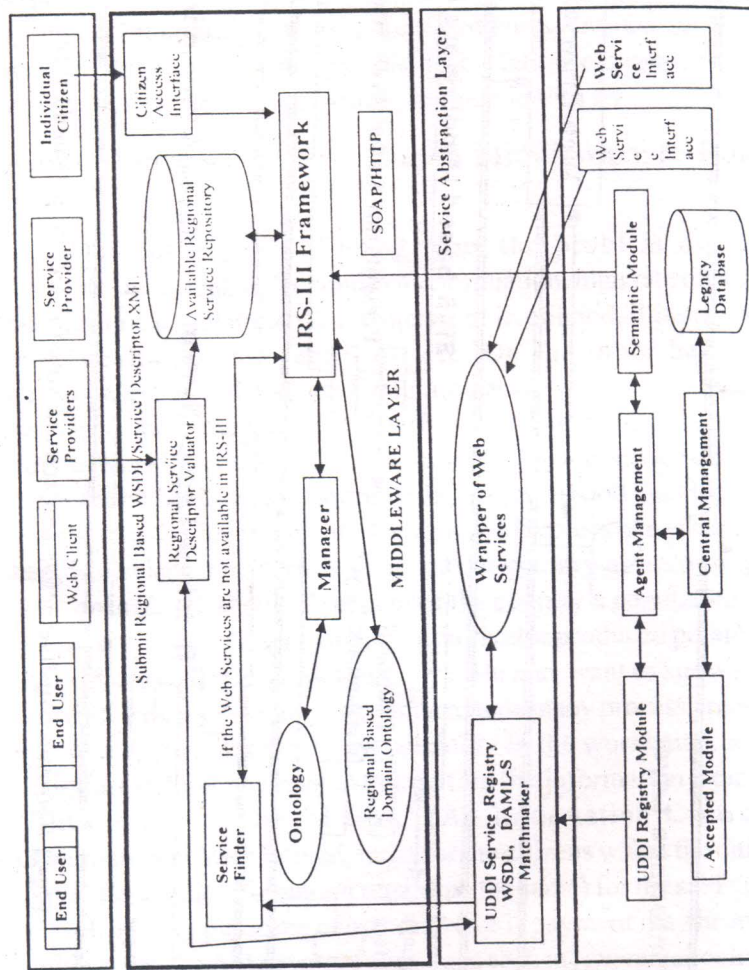


Figure-1: A Conceptual Model for Workflow of the Services in SWS based E-Government

own published capability. **Semantic Module** is used to match the semantic uniformity between the insider & outsider system to afford the semantic module to other components. **Central Management** component form a consistent whole interactions of all the modules. **Agent Management** component manages to insider agents & information exchange with exterior agents.

Here we proposed of service definition repository and valuator in the system. The descriptions of them are given below: **Regional Based Service Definition Repository**: a database of all available state/local government service descriptors from all government levels and agencies to discover and connect to available agency services this repository will act as the resource repository for e-services description discovery engine of IRS-III. **Regional based Service Definition Validation**: It is a web application that enables all state/local government agencies to register themselves and submit their services. Member agencies would submit their services descriptors in a WSDL format by using their username and password provided by the main agencies, then the system will test and validate all the deposited service descriptors to insure the compatibility and interoperability. **Accepted module** receives, delete, update, and register the user queries with unexecuted queries. **Domain expert** will collect the unexecuted query for their testing and checking so that next time he can add the tested query. **Middleware Layer** acts as an interface between the service requestor and service provider. Citizen can use the services efficiently and convenient to use the model. The core component of the SWS based Middleware is ontologies [9, 10]. The service ontology consists of Goal Ontology, Web Service Ontology and Mediation Ontology illustrated in [11]. First, Ontologies can provide the grounding data model of the integrated model, thus describing the structure and content in a coherent manner. Second, the information items in a model can be semantically annotated and ontology-techniques can be used for much more efficient information management. Third, ontologies enable automated information exchange over the web which allows interoperation of Model and other Semantic Web applications.

Requirements for SWS based Middleware in E-Governance

The delivery of e-government services needs some requirement inherent in the mission of government itself, because e-government is not like the e-services such as e-business where the user has the option to choose the service of a specific business on the other hand citizens have right to enjoy all the services of their own government. The achievement of the SWS based middleware E-government service delivery is listed below i) Maximum accessibility such as simplicity of front-end logic, multi-linguality of user interfaces, anywhere/anytime availability, no demands for end-user IT skill ii) Maximum benefits like quality and performance of service and added value of the content iii) Minimum costs (transportation, communication, document management) [12][13]. True E-governance calls for composition, invocation, presentation and delivery of e-government services in one-stop fashion that means on a conceptual level, services need to be compiled into some sort of service bundles around single real-world situations where they apply. The said service bundle must be logically represented at the GUI level as responses to single real world problems.

A Logical View of System Architecture of SWS based Middleware in E-Governance

In this section, we propose a conceptual view of the system architecture for the transaction of e-services between the Citizen/ User and the government agency using the proposed middleware. There are three layers in our proposed architecture i) **User interface layer**, ii) **SWS based Middleware layer** iii) **Service Provider Layer**. **User Interface layer** – It is a GUI based interface by which a user, Citizen can access the e-services from the governmental agency in a single web interface. The user can submit their requirements in this layer with regional based form. ii) **SWS based Middleware**- It is a main layer of our proposed architecture which is discussed in section 3, works as an interface between the service

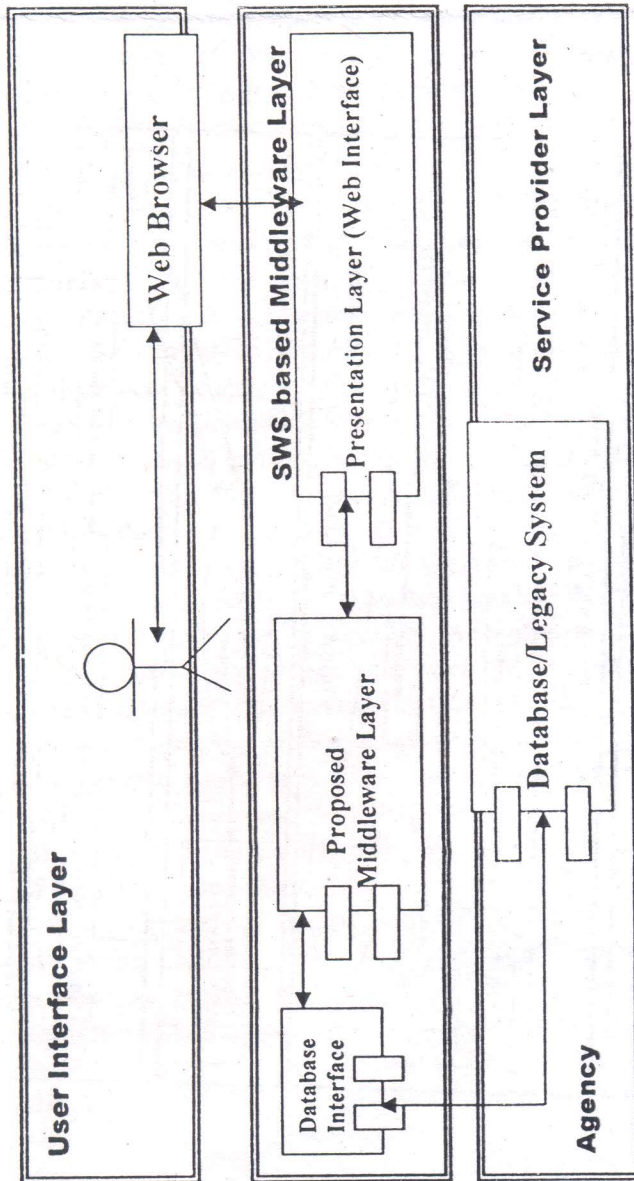


Fig-II Illustration of Interaction between Middleware Architecture and Citizen

provider and service requestor. It also solves the problem of semantics between the user and service provider. The main goal of this approaches are e-government services convenient to use and user can use the e-services efficiently as per their needs. lii) **Service Provider Layer** – it is a layer of the governmental agencies, which stores the information of the government as a web service. All the e-documents and information exposed as web service in this layer for providing to the middleware.

Applicability of the SWS based Middleware in Rural Areas

Our country is suffering from the problem of huge unemployment and under employment situation, high rate of below poverty line population, lack of means of livelihood, illiteracy and poor health service facilities, etc. On the other hand the development of Information Communication Technology System has placed our country in the list of the top five countries through out the World. Our main objective is to develop the service oriented SWS based Middleware not only for the livelihood development but also for the development of other social sectors like education, health services etc. of rural areas of our country as according to the Census 2001 about 67 percent of the country's population live in the rural areas. As for example, a cultivator produced potato but the cost of production is not lucrative. He may want to know from the SWS base e-governance system that how many process products are there from potato and its availability in the world market and their cost in Indian money. After getting the information from the "Tathya Mitra" and 'Kiosk' (An Information Centre of Government of West Bengal, India for the citizens where the citizen may collect their information regarding the same) for the said query of him, he may put some constraints like i) payment may be made within seven days ii) payment must be in cash iii) guarantee delivery system of the product. All the above constraint he may submit in the GUI based User Interface Layer to get his particular needs. On the other hand service provider creates the web service for the user requests, so when the user query is executed the process manager will discover the related information and their cost for

the farmer and the potential buyers. It may be pointed out that the buyer will be given some constraint regarding the purchase of product like i) payment will be paid by only draft ii) they will provide the sending cost of the product if the amount of goods are maximum amount. Finally chooses a lot of buyers who satisfy the constraints of the seller. The cultivator will get the direct benefit from the services. And he will be very much interested to use more land for the cultivation of potato in the next year which will generate more employment in the local area which is our ultimate target.

Conclusions and Future Work

In this paper we have proposed SWS based middleware for e-Governance, which is sufficiently expressive for specifying conceptual and operational building blocks for the basic interaction involved in e-governance world. Adding Semantic Web Services (SWS) based Middleware in e-governance like ours (Indian context) is not an easy task due to the complex domain of e-governance. Researches on the said topics are an early stage. Though there are few success stories (projects) which have successfully completed their projects in European Country, but still have a long way to go in implementing the models. Our future work will be concentrating on modeling the knowledge-base more semantically to develop the concrete middleware. For developing the good user interface layer, some new technologies like hibernate, spring, Ajax will be used. We are going to develop a prototype SWS based Middleware of E-governance using IRS-III framework for the creation and execution of the semantic web services for the livelihood of rural development in our local block level Chakdaha, West-Bengal, India. The implementation of Regional based web services using WSDL [6] semantically enriched and the use of regional based domain ontologies to semantically enable web services and structuring knowledge are the critical technical issues. To the best of our knowledge, up to this time, no techniques have been used to enrich Trust & Reputation Systems with semantics in E-Government for the middleware. We are going to develop a regional based (Bengali) web services for the middleware.

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