

# Semantic Web Services-A Survey

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**Abstract--** The technology where the meaning of the information and the service of the web is defined by making the web to understand and satisfies the request of the people is called Semantic Web Services. That is the idea of having data on the web defined and linked in a way that it can be used by machines not just for display purpose, but for automation, integration and reuse of data across various application .The idea of the semantic is raised to overcome the limitation of the Web services such as Average WWW searches examines only about 25% of potentially relevant sites and return a lot of unwanted information, Information on web is not suitable for software agent and Doubling of size. It is built on top of the Web Services extended with rich semantic representations along with capabilities for automatic reasoning developed in the field of artificial intelligence. This survey attempts to give an overview of the underlying concepts and technologies along with the categorization, selection and discovery of services based on semantic.

## 1 INTRODUCTION

Web Services are self-contained application that is used for the communication between electronic devices over internet. It uses XML- based interfaces for communication which includes the operation like publish, bind, find of the services by the service role.

The Semantic web used to categories the services and retrieves those services from UDDI based on meaning that enable dynamic, execution-time discovery, composition, and invocation of Services[1] and machine to use the web content.

The goal of Semantic Web Services is to satisfy the user by providing services from web. [1] Basically, Web services structure a service oriented architecture where the service register (UDDI) has predefined categories (syntactic) that are specified by the service provider. As a result, similar services may be listed under different categories in existing UDDI infrastructure. This may involve searching a large number of categorize to find appropriate services. Therefore, need of categorize web service based on their semantic rather than classification of service provider.

A Web Service is an application component accessible over open protocols which are intended to solve three main problems such as Interoperability, Firewall traversal, Complexity.

An application component that Communicates via open protocols (HTTP, SMTP, etc.) ,Processes XML messages framed using SOAP ,Describes its messages using XML Schema , Provides an endpoint description using WSDL and can be discovered using UDDI.

The Web Services architecture (fig:1) is based upon the interactions between three roles [2]: Service provider, Service registry, Service requestor. The interactions involve with the help of three main operations such as Publish, Find, and Bind.

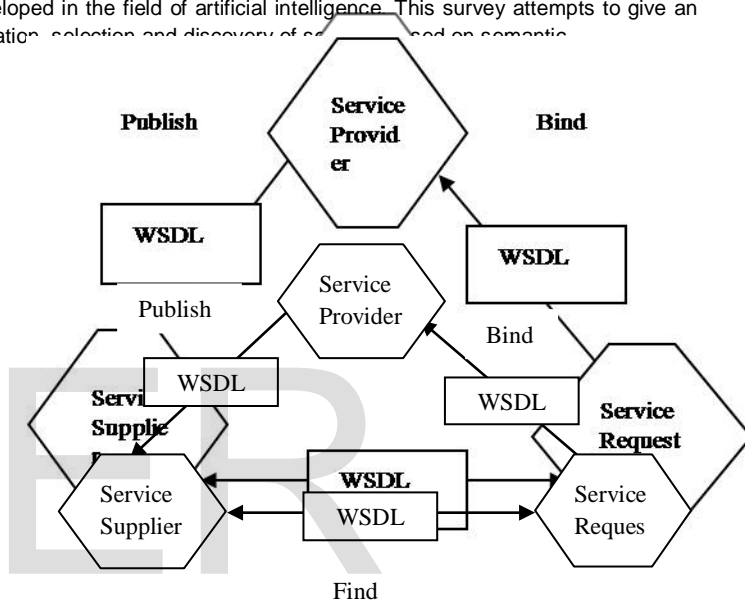


Figure 1: Architecture of Web Service

Service Requester is a person or organization that requests the provider to their entity's web service. The provider gives appropriate agent to implement particular service. Service Requester locates the desired service; its client binds with the service at the service provider and then invokes the services.

Web Services uses four protocol stacks that used to define, locate, implement, and make web service to interact with each other. They are: Transport Protocol – Responsible to transporting message between network application and it include protocol such as HTTP, SMTP, and FTP. Messaging Protocol -Encode the message in XML format and include the protocol such as XML RPC, WS addressing, and SOAP. Description protocol –Used to describing the public interface to specific web service by using WSDL. Discovery protocol –Centralizes services into common registry by using UDDI.

A SOAP message is an ordinary XML document containing the following elements: A required Envelope element that identifies the XML document as a SOAP

message. An optional Header element that contains header information. A required Body element that contains call and response information. An optional Fault element that provides information about errors that occurred while processing the message.

UDDI is platform independent, Extensible Markup Language based registry by which different services listed on internet [3]. This is provided by Organization for advancement of structured information standards. Core of web services standards designed to be interrogated by SOAP message and provide access to WSDL describing the protocol bindings. The message formats required to interact with web service listed in the directory. UDDI nodes are servers that support UDDI specification and UDDI registry has one or more nodes.

## 2 THE SEMANTIC WEB

The Semantic Web provides a common framework that allows data to be shared and reused across application, enterprise, and community boundaries [12]. It is an effort to enhance current web so that computers can process the information presented on World Wide Web, interpret and connect it, to help humans to find required knowledge [4].semantic web is intended to form a huge distributed knowledge based system.

In the architecture (fig:2), URI and Unicode, follows the important features of the existing World Wide Web. Unicode is a standard of encoding international character sets and it allows that all human languages can be used (written and read) on the web using one standardized form. Uniform Resource Identifier is a string of a standardized form that allows to uniquely identifying resources. A subset of URI is Uniform Resource Locator, which contains access mechanism and a network location of a document. Another subset of URI is URN that allows identifying a resource without implying its location and means of dereferencing it.

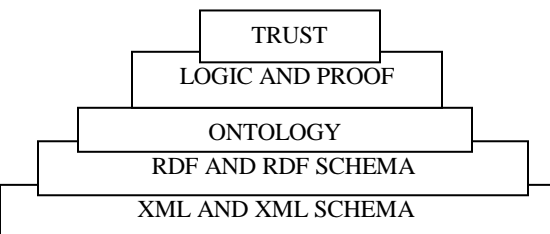


Figure 2: Architecture Of Semantic Web

The layer of the semantic web as follows(fig:1.2): The lowest layer is XML and XML schema responsible common schema, data type and structures [1].RDF and RDF schema describes the resource type and metadata that uses the XML notation to represent pieces of information as propositions and that can form general graph-like structures. Propositions are represented in the form of subject predicate-object -triplets and terms used are uniquely identified with URIs.

Web Service Description Language [1] is an XML vocabulary for describing Web services that allows developers to describe Web Services and their capabilities, in a standard manner.

Ontology is the language used to define vocabularies and establish the word and this is constructing by RDF Schema. Logic is used to establish the consistency and correctness of data set and proof is used to explain the steps for reasoning [1].The top layer the trust which provides the authentication and trustworthiness of services, agent and agent [1].

## 3 SEMANTIC WEB SERVICES

The development of Semantic Web Services is to enrich the underlying Web Services [5].Since all the web resources have one or more themes along with some number of concepts .If these concepts can be discovered and matched with the concept contained in a query then this will be the best method of retrieval of information from web and this can be achieved by Semantic Web Services [13].

Categorization of services based on semantic from a hierarchical by using Association rule and register in UDDI. Selection can be done in two steps 1) Parameters-Based service refinement 2) Semantic similarity-based matching. Let we discuss about the techniques to Coordination, Matching, Discovery of services.

### 3.1 Framework Representation Of Semantic Web Services

To work with Semantic Web Services there needs to define the relevant information reasoning problems and solutions to the problems in a consistent manner. Three large proposals for such representation frameworks have been presented: OWL-S, WSMO, and SWSF.

OWL-S uses description logic (OWL) as the basic language for service ontology. WSMO stresses the loose coupling between services and attempts to achieve this with separate goal and service ontologies and advanced mediator architecture. SWSF is based on OWL-S but improves its process model by incorporating an existing ontology, Process Specification Language (PSL).

### 3.2 Semantic Web Service Coordination

The coordination of web services includes the matching of services and discovery. Semantic service matching determines whether the semantics of a desired service conform to that of an established service. A current approach to semantic service matching depends on non-logic-based or logic based reasoning or a hybrid combination of both, within or outside the respective service description framework.

Table 1. Supported semantic web service description formats

Name of the Techniques	Features

➤ OWL-S Matchmakers	1) Logic based semantic Matchmakers for OWL-S service are the OWLSM and OWLS-UDDI focusing on service IO matching. 2) PCEM that converts OWL-S service to PDDL for matching.[14]
➤ WSML Matchmakers	This encompass with WSMO-MX (hybrid semantic Matchmaker), GLUE(Logic based) syntactic search engine in P2P networks.[15]
➤ WSDL-S/SAWSDL Matchmakers	1) Tool used here is METEOR-S WSDI discovery infrastructure and UDDI based Lumina3. 2) It is Key word based searching. Supported semantic web service description formats
➤ MonolithicDL-based Matchmakers	Semantic service matching is done within the logic theory that is performed by RACER, MaMaS4. Now it is implemented in OWL-DL extended with

	non-functional.[16]
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Based on the above mentioned description formats different techniques is framed for service matching [8]. As follows

**Table 2. Different techniques for service matching**

S.No	Name Of The Techniques	Features /Limitations
1.	Service profile and process model matching	1) profile matching called as a " black box " determines the semantic correspondence between the service 2) This encompass input, output, pre, post conditions, non functional aspects, and also Operational behavior[20].
2.	Logic- based semantic service profile matching	1) Based on descriptive format, logic based semantic matchmakers perform deductive reasoning on semantic service 2) To implement this logical concept , rules will be framed from the ontologies as first order or rule based theories. 3) Based on this theories frames the matching degree. 4) Monolithic logic based service matching and service specification matching are the two type matching based on this type of techniques[21].
3.	Service signature and IOPE Matching	1) Semantic matching(Logic) of service signatures called service profile IO-matching. 2) It is stateless matching of declarative data semantic by logical reasoning[22] .

4.	Non-logic based semantic profile matching	Based on description format it do not perform logical inference on service semantics but they compute the degree of matching.
5.	Hybrid semantic profile matching	1)It is combination of crisp logic based and non-logic based semantic matching. 2)LARKS has been the first hybrid semantic service IOPE matchmaker. 3)It uses selected token based string similarity metric to calculate the degree of text similarity based matching.
6.	Logic-based semantic process matching	Matching of process models of OWL0S services grounded in WSDL inorder to reduce to the match of corresponding WSDL service orchestrations in BPEL.
7.	Non-Logic based and hybrid semantic process model matching	1)Framing dependency graphs based on syntactic similarity measurement. 2)Based on workflow operation and logic match between input and output connect the service node of the graph.

### 3.3 Semantic Web Service Composition

Semantic Web service composition is the process of combining or bundling the services to meet the needs of a user. Automating this process is desirable to improve speed and efficiency of user responses.

#### 3.3.1 Web Service Composition

In general, Web service composition is similar to the composition of workflows used by the existing techniques. The user need to give the query which can be partially relate to the required services [11]. In particular, the approach to composition is to have a single entity (orchestration and choreography) between WSDL services in BPEL. In fact, the majority of composition planners for Semantic Web services based on logic-based AI planning. In the following, we focus on these approaches to Semantic Web service composition followed by discovery of services.

#### 3.3.2 AI-Planning-Based Web Service Composition

The service composition problem is the state-based planning problem in AI. Classical AI planning-based composition performed under the assumption, no condition focuses on the description of services as deterministic state transitions (actions) with preconditions and state altering (physical) effects. Actions are applicable to actual world states based on the evaluation of preconditions and yield new (simulated) states where the effects are valid.

### 3.4 CLASSIFICATION OF SEMANTIC SERVICE COMPOSITION PLANNERS

In general, any AI planning framework for Semantic Web service composition can be characterized by 1) the representation of the planning domain and problem to allow for automated reasoning on actions and states. 2) The service semantic method is the planning method applied to solve the given composition problem in the domain.

We can classify Semantic Web service composition planners according to the two criteria, which yields the following classes.

- Dynamic or static Semantic Web service composition planners depending on whether the plan generation and execution are inherently interleaved in the sense that actions (services) can be executed at planning time, or not.
- Functional-level or process-level Semantic Web service composition planners depending on whether the plan generation relies on the service profile semantics only, or the process model semantics in addition.

Table 3. Composition of the Services

S.No	Name of the Techniques	Features/ Limitations
1	Static and Dynamic Composition	1)GOAL,MetaComp, PLCP,RPCLM-SCP and AGORA-SCP are static classical planners. 2)The dynamic composition planners allow to execution of information gathering but no word state altering services. 3)But during planning,

		advanced and reactive dynamic composition planners takes non-deterministic world state changes[23] .
2	Functional –level composition	<p>1)Functional level(FLC) consider the service as atomic or composite black box action.</p> <p>2)The function is to execute in a simple request-response without interaction patterns.</p> <p>3)This generates a sequence of semantic web service base on their profile that matches with the desired service.</p> <p>4)This uses proprietary composability rules for generating possible plans of hybrid semantic IO matching[24].</p>
3	Process –level composition	<p>1)Process level extends FLC planning</p> <p>2)That is this include the internal complex behavior of exiting</p>
4	Static semantic service composition planners	<p>1)The class of static Ai planning –based composition covers classical and non-classical planning approaches.</p> <p>2)This plan under the assumption of a closed, perfect world with deterministic action and</p>

		observable domain at design time. 3)Classical AI planners are static since their plan generation and execution is strictly decoupled.
5	Dynamic composition planners	<p>1)This include restricted , advanced and reactive dynamic planning under uncertainty.</p> <p>2)<b>Restricted Dynamic planning :</b> Action execution at planning time is restricted to information gathering about uncertain action outcomes to add a new knowledge.</p> <p>3)<b>Advanced Dynamic Planning:</b> This method allow to react on arbitrary changes in the world state .</p> <p>4)Its interleaved execution of planning with world state altering service is prohibited to prevent inconsistencies and conflicts.</p> <p>5)<b>Reactive Dynamic Planning:</b> It produce set of condition action or reaction rules for every situation.</p> <p>6)Interleaved planning and execution is derived from state condition</p>



		with help of rules.
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### 3.4 SEMANTIC WEB SERVICE DISCOVERY

A web service discovery process is carried out in three major steps. First step is advertisement of web service by developers. Providers advertise web services in public repositories by registering their web services using web service description file written in WSDL [9]. Second step is web service request by user. User sends web service request specifying the requirement in predefined format to web service repository.

Web service matcher which is core part of web service discovery model, matches user request with available web services and finds a set of web service candidates. Final step is selection and invocation of one of the retrieved web service (fig:3) The different techniques to discover the services are tabulated as follows [9][10].

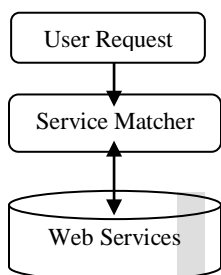


Figure 3: Discovery Of Services

Table 4. Techniques for discovery of services

S.No	Name of the Techniques	Features/ Limitation
1	Context aware web service discovery	1)The format of request is fixed in web service so there is some chance of loss of information. 2)This can be overcome by context aware discovery. 3)This techniques are useful for request optimization, result optimization, personalization and better than keyword matching techniques. 4)Context is divided into

		Explicit and Implicit 5)Explicit context is provide directly by user during matchmaker process. 6)Implicit context is collected in automatic or semantic manner and not directly provided by user. 7)According to context collected it further divided into profile oriented context, usage history oriented context, process oriented context and other context.[18]
2	Publish Subscribe Model	1)In this, request is provided with the priority to discovery. 2)This uses Semantic based web service matching and by using concept matching it rank the services. 3)Divides the system in to Subscription phase and notification phase. 4)Information is used from the knowledge base and matching is performed. 5)Limitation is it adds overhead in developing and maintain new components in system architecture.
3	Keyword clustering	1)It calculate similarity matrix of words in domain ontology based on pareto

		<p>principal.</p> <p>2)And by semantic reasoning finds the matching service.</p> <p>3)Bipartite graph is constructed using Kuhn-munkres algorithm to find the match.</p>
4	Service request Expansion	<p>1)In this, build the request vector and training set of the LSI by combining service request and latent semantic indexing.</p> <p>2)LSI includes singular Value Decomposition(SVD) original matrix is approximated by a linear combination of a decomposition</p> <p>3)By using cosine measure similarities are found and linking of ontology is done by semi automated approaches.</p> <p>4)The cost of computing LSI and string SVD is high is the limitation of this technique.</p>
5	BPEL processes Ranking using graph matching	<p>1)If the service does not match exactly then service matcher suggested the approximation matching.</p> <p>2)In this case, BPEL specification transform to</p>

		<p>behavior graph were regular nodes is the activities , connectors are splits and join rules.</p> <p>3)The algorithm traverses the nested structure of BPEL control flow in a top-down and apply transformation procedure</p> <p>4)It also handle five structural activity sequence, flow, switch, while and pick.</p> <p>5)Ranked in decreasing order to calculate distance between the graph and web service.</p>
6	Layer based semantic web discovery	<p>1)By applying filters searching is divided into three layers.</p> <p>2)The layers are service category matching, service functionality matching, quality of service matching.</p>
7	Service discovery in Heterogeneous networks	<p>1)Interoperability should be ensure in heterogeneous network by using service discovery gateways between the domain that translates between different service discovery environment.</p> <p>2)To enhance this, have implemented a gateway prototype solving transparent interoperability between WS-</p>

		Discovery and a cross-layer solution
8	Agent based discovery considering QoS	<p>1)By using QoS parameter, we can select best service among multiple services.</p> <p>2)Web service discovery framework has a separate agent for ranking the services on the basis of QoS which verify and certify the services.</p> <p>3)Time required for selecting the web service based on QoS decreases the time.</p>
9	Peer-to Peer discovery	<p>1)Discovery is based on the process behavior.</p> <p>2)The web service p is a triple, <math>p=(L,S,R)</math>, where, L is the implementation, S is the service, R is the set of request.</p> <p>3)All service is represent using finite automata and matching can be found by sending PFA.</p> <p>4)Matching is again done against S by hashing the finite automaton on to the chord ring.</p> <p>5)Chord is the peer to peer system for routing a query on hops using hash table.</p>
10	Hybrid Approach	1)Discovery of services based on keyword based and ontology based.

		<p>2)Overall similarity between query and web services is calculated as weighted sum using association rule.</p> <p>3)This gives the better result than the text based approach.</p>
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#### 4 CONCLUSION

The research around Web Services is intense and there is a lot of interest in finding ways to create an infrastructure where services could be described that should allow dynamic discovery, composition and invocation even the web service standards and recommendations become complex. Many concepts and methods from artificial intelligence research have been brought into the work. The development of the Semantic Web has been characterized by the input from the knowledge representation community and AI Planning research has had a big impact. However the aim to satisfy the people by providing easy surfing over the web and also retrieving the information from the large distributed web resources.

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