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Dynamic Establishment Of Sla With Automated Negotiation And Privacy Policy For E-Business Application

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Abstract--**The Service Level Agreements (SLA) are e-Contracts that need to be established among business partners and monitored to ensure that web services comply with the agreed Quality of Service values. Establishment of SLA among the component services of a composite service and the users becomes important. The establishment is time consuming when done manually because it involves negotiation of parameters to be agreed by the participants. Hence an algorithm is proposed for automated negotiation and a framework for automated contract establishment is designed and implemented. For web services to be successful, privacy must be protected. Today, privacy has become more important concern for both users and web service provider. More people will use web services if they feel all the information released are secure enough. Privacy can often be guaranteed through security measures. To enable privacy protection for Web services, customers are allowed to specify their preferences about the disclosure of their information. In this paper its demonstrated with a suitable e-Business application of Purchase and Registration of Vehicles along with the privacy is ensured during composition of the individual web services for the customer's details.**

Keywords- **Dynamic SLA,Automated Negotiation, Establishing WSLA, E-Contracts, SOA, Web Services, Privacy in Web Services.**

I. INTRODUCTION

Service Oriented Architecture (SOA) [1] is an architectural style for building software applications that use services available in a network such as the web. It promotes loose coupling between software components so that they can be reused. Applications in SOA are built based on services. A service is an implementation of well-defined business functionality, and such services can then be consumed by clients in different applications or business processes. SOA is most commonly implemented with Web Services.

Web services are software systems designed to support interoperable machine-to-machine interaction over a network. Web Services allow businesses to expose their business functionality through the Internet which can then be accessed by anyone wishing to use the business function. The interoperability is gained through a set of XML-based open standards, such as WSDL, SOAP and UDDI. These standards provide a common approach for defining, publishing and using web services.

A business function may be provided as a Web Service by many service providers. Selection of the best service among the available ones becomes important Apart from user preferences, Quality of Service (QoS) parameters become selection criteria to allow users choose the best service provider based on their individual requirements.

This is where Service Level Agreements (SLA) come into the picture. An SLA is an e-Contract which spells out the QoS that a particular service provider has agreed to offer.

A scenario is considered where the user needs to buy a vehicle in an Secure environment. Secure Envirnoment is important because This requirement cannot be satisfied with a single service as it involves multiple activities from different departments. The BDR issues SSN (Social Security Number) for every individual. Before buying a vehicle, the user identity has to be verified with the BDR department. Here, the BDR verify service is used to verify whether the user input SSN is correct or not. Upon selecting the vehicle according to the user needs, it must be insured. Insurance firm's issue policy service must be used for getting an insurance policy for the vehicle with an appropriate policy scheme.

The insured vehicle needs to be registered in the RTO office to get a registration number for the vehicle. RTO's register service is required for registering the purchased vehicle. Finally the vehicle can be purchased from the dealer after payment. Dealer's purchase service must be used for actual purchase of the vehicle. Hence, 'BuyVehicle' is offered as a composite service through the portal that is a composition of four component services.

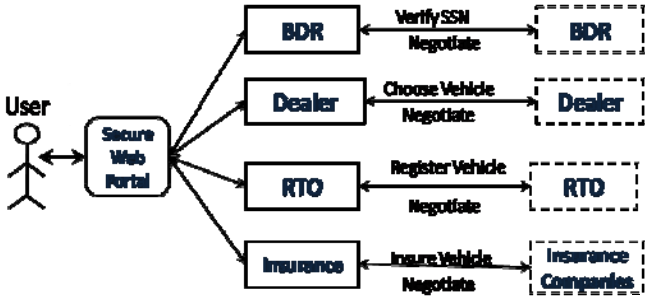

Fig 2. Component Services of BuyVehicle

The constituent services are provided by BDR (Birth/Death Registration), automobile dealer, insurance firm and RTO (Regional Transport Office). Two providers for each type of service of which one is selected after negotiation are considered.

II. SYSTEM ARCHITECTURE

There are three main modules in our system, namely Negotiation and Agreement Utility, Privacy monitor and Request Manager. The system architecture is depicted in Fig. 3. Apart from these, the portals of individual service providers and the web services deployed by them are designed and implemented.

The service requests by the consumer are first handled by the Request Manager. The requests are then forwarded to the Negotiation and Agreement Utility. The Negotiation and Agreement Utility is responsible for the initiation of composition of the required services. The Privacy monitor is responsible for the privacy of the user information. Based on the user's request, the constituent services of the composition are determined using BPEL templates. Contract is generated by the Negotiation and Agreement Utility in four phases: Contract definition, Negotiation, Contract establishment and Contract enactment[2]. Contract is generated by the e-Contract manager in four phases: Contract definition, Negotiation, Contract establishment and Contract enactment.

A. *Contract Definition:* In this phase the schema of the contract that has to be established is defined. We use the WSLA [7] specification. WSLA has three sections namely Parties, Service definitions and Obligations. Parties section gives the contact details of the providers, consumers and the supporting parties of a service. Service definition section specifies the definitions of SLA parameters and references to service operations and bindings. The actual guarantees and service level objectives are defined in the obligations section.

B. *Negotiation:* In this phase, negotiation among the participating services and the user is done based on the previous performance of the services. The objective of negotiation is to derive the best values of parameters of the contract from the available participants. Negotiation is done between providers of same type of service.

C. *Contract Establishment*: Once the negotiated values are agreed by all the participants of the negotiation, the contract is established. The contract file is generated with the agreed values in it.

D. *Contract Enactment:* The values in the contract are monitored during this phase. The real execution values and the values from the contract are compared by the policy manager. In case of violation of the contract, a violation message is recorded in a log.

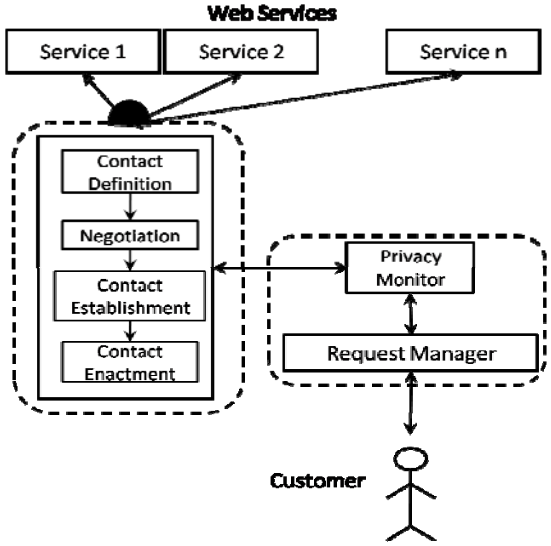

Figure 3. Dynamic Composition Framework

III. NEGOTIATION

The negotiation module manages the negotiation between the user and the providers. A requirement for negotiation is each provider has to implement 'Negotiate' service. Negotiation with each constituent service is done by a 'Negotiator'. In Fig. 3, N1, N2, N3 and N4 are negotiators. The negotiators are managed by a central

‘Negotiation Coordinator’. The negotiation coordinator is responsible for checking whether the total negotiated values of the constituent services satisfy the requirements of the user. Negotiators and the coordinator reside in the portal. The negotiation of QoS parameters such as execution time and price has been attempted by assigning equal weights to them.

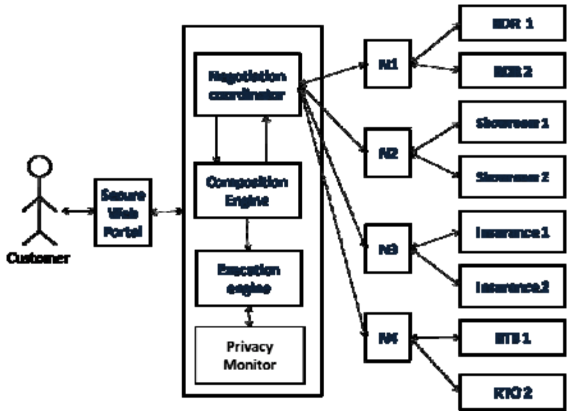

Fig 4. The Architecture for Negotiation

The first step in negotiation is the division of the user’s proposal among the negotiators. This is based on the complexity of the services involved. Each negotiator starts the negotiation by sending the proposals from the negotiation coordinator to its own set of providers. Counter proposals are exchanged between them until one of them accepts the offer or the timeout occurs.

Counter proposals are generated by giving concession or tradeoffs to the incoming proposal. The service providers give concessions till the average value is reached. After that they switch over to tradeoffs. At any point if the negotiator finds that the utility of incoming proposal is the same or better than the utility of the negotiator’s previous proposal, the algorithm is terminated, the provider that offers such a utility is selected and its offer is accepted. Otherwise they negotiate till a fixed timeout.

A. Dynamic collaboration:

A contract language, Web Service Collaborative Contract Definition Language (WS-CCDL) as well as the mechanisms for instantiation and termination of the collaboration have been designed[10]. WS-CCDL is used for dynamic multiparty collaborations and captures the contributed resources and negotiated agreements on them. The language itself has been defined using XML Schema and has been implemented in a dynamic collaboration platform to provide a connectivity service. WS-CCDL overcomes the inability of WSLA to add more participating parties in the contract. It also addresses the issue where a single party plays the role of both service provider and service consumer. A contract is a collaborative context that specifies not only the requirements for the collaboration but also captures the contributions made by the participants as well as the agreements between them for contributed resources. The contract includes collaboration requirements, contributions by participants, agreements among participant and the list of participants.

The eContract as a format for capturing and distributing contributed resource in the context of dynamic collaborations[9]. An agreement protocol and a simple distributed algorithm for negotiating the eContract is also proposed. From the insights gained from the analysis of the proposed negotiation algorithm, an efficient “message piggybacking” negotiation algorithm has been developed. Establishing an eContract in the context of dynamic collaboration is distinguished by the following features:

a) All entities participating in the collaboration play the roles of both service provider and consumer.

b) All entities participating in the collaboration (as service consumers) must agree with the contributions made by other entities (as service providers).

c) All entities contribute resources such as data, applications, facilities and storage and networking infrastructures for the collaboration(as service providers).

But negotiations have not been automated for dynamic collaborations. The negotiation algorithm given in requires human negotiators for generating proposals and counter proposals[9].

B. Contract establishment

There have been numerous contributions for contract establishment between two Web Services. There are several standards such as WSLA and WS-Agreement for defining contracts. Various standards for contract languages are compared by analyzing features such as contract definition, automatic contract deployment, contract measurement (monitoring) and contract evaluation (analyzing) and contract termination. In the base components in a typical SLA that are needed to make it precise and flexible have been identified.[14] The authors specify that precision and flexibility of the contract model help in automation of contract management.

An architecture for establishment and monitoring of SLA hierarchies spanning through multiple domains and layers of a service economy has been proposed in [3]. The paper also proposes an architecture for SLA monitoring satisfying two requirements: availability of historical data for evaluating SLA offers and the assessment of the capability to monitor the terms in a SLA offer.

Another framework for automated contract specification and establishment proposed in [4] deals with the contracting process is by selecting services from a set of functionally equivalent services mediated by a contract broker. The contract broker performs the process in three phases, namely, Matchmaking, Provider Selection and Agreement Configuration. Algorithms for selection of service providers through matchmaking and agreement configurations have also been proposed.

Quality model for Web Service QoS contracting, the QoS Service-Level Agreement model and classification of QoS dimensions have been presented. In addition, the dimensions are classified based on different criteria as domain-dependent and domain-independent dimensions, ordinal and categorical dimensions and negotiable and non-negotiable dimensions.

C. *Automated negotiation*

The approach for automating the negotiation of business contracts proceeds in three broad steps. First, the structure of the negotiation process is determined by applying general knowledge about auctions and domain-specific knowledge about the contract subject along with preferences from potential buyers and sellers. Second, the determined negotiation structure is translated into an operational specification for an auction platform. Third, the negotiation results are mapped to a final contract. A prototype system for automating negotiation called ‘AutoContract’ has been proposed.

A data model proposed in [8] describes negotiation preferences and the resulting contracts. It is described, how proposals of contracts are to be compared with the preferences for acceptance and what steps of negotiation can be taken. This model is examined for privacy contracts between Enterprises and their customers.

A framework in which the service consumer is represented by a set of agents who negotiate quality of service constraints with the service providers for various services in the composition has been proposed in [16]. This negotiation is well coordinated in order to achieve end-to- end quality of service requirements. Based on this framework, a new negotiation protocol is presented to support coordinated negotiation. A utility-function-based decision-making model is proposed based on which agents can proactively decide on the course of further actions. A utility function represents the satisfaction level of user or provider for an offer. The value of utility lies between 0 and 1. It is calculated as

$$u(t)=\frac{\max - x}{\max - \min} \qquad (1)$$

if the party aspires for the minimum and as

$$u(t)=\frac{x - \min}{\max - \min} \qquad (2)$$

if the party aspires for the maximum. Here, x is the value for which the utility is being calculated and max and min are the maximum and minimum that can be expected from the party. The total utility is calculated as

$$u_t(t)= \Sigma_i (w_i * u_i)$$
$$\forall i= 1 \text{ to } n, \Sigma_i w_i = 1 \qquad (3)$$

where n is the number of parameters, w_i is the weight for the parameter and u_i is the individual utility value.

Algorithms for Tradeoff and Concession have been proposed for generating counter-proposals in negotiation. To compare all the negotiation attributes, they are marked over a common utility space. An acceptance range is marked in this space. Concession seeks, within the acceptance range, a point with a fixed deduction of the total utility value of the current-offer while the trade-off algorithm seeks, within the acceptance range, a point which has the same total utility value with the current-offer.

A tradeoff-based automated negotiation approach described in [12] employs an iterative tradeoff mechanism for evaluating opponent’s offers and generating counter- offers of mutual gain based on selected quality of service parameters. A negotiation algorithm and an offer-generation algorithm have been proposed to generate counter-proposal from current-offer for Web Service Procurement.

The PANDA approach [6] automates decision-making and specifies a negotiation policy, expressing a party’s private negotiation strategy, by combining rules and utility functions. It proposes a mechanism for the specification of a party's negotiation policy, i.e. the private specification that guides the analysis of offers and creation of responses. This policy is executed by decision-maker components within the PANDA framework. The combination of multiple decision makers facilitates the decomposition of the policy. Using this approach, the user can divide the decision problem into manageable units. PANDA has a template-based approach to represent the negotiation object and can deal with arbitrary service contracts. The high-level rule language helps keeping programming requirements low. In addition, the framework facilitates the involvement of users in the decision-making process, if necessary.

A Negotiation Broker (NB) middleware framework [17] facilitates automated negotiations of SLAs for Web services in a Service Oriented Architecture (SOA). High level business goals, contexts, preferences, constraints, and values of the negotiation issues are expressed as a policy specification by each of the negotiating parties. The NB maps the policy specifications to low level negotiation strategy models and parameters in order to conduct the negotiation locally as a trusted broker. A model and an example of the high level negotiation policy specification are presented. NB framework includes a prototype implementation to illustrate the mapping of the policy to a time-dependent negotiation strategy model. A negotiation Decision Support System (DSS) is used. The DSS determines the possible combination of issues, values of the issues based on the previous offer and determines the best values for the issues to offer next to achieve the negotiation goal.

The literature survey shows that there are many contributions for Web Service monitoring. But those works do not deal with automated generation of contracts. Recently, some frameworks[4][6] have been proposed for automated negotiation. However, these frameworks do not consider composite services. A framework proposed in deals with automated negotiation in the context of composed Web Services[16]. However, the contract generation is not automated. In addition, the accuracy of the proposed negotiation algorithm needs to be improved as there exists an ambiguity over when to use concessions and when to use tradeoffs. Therefore, in this project, an improved automated negotiation algorithm has been proposed which ensures highest satisfaction level of the providers as well as consumers. Multiple agreements are generated in a negotiation process and the best agreement is selected based on the satisfaction levels. The agreed SLA between providers and consumers are generated as WSLA documents. WSLA is an IBM standard for contract specification and is suitable for e-Contracting in B2B applications as it can accommodate specification of SLO and SLA of functional and non-functional parameters and their monitoring.

IV. PRIVACY IN WEB SERVICE COMPOSITION

The government allows citizens to interact with its online service for Registration of Vehicles related issues. As the user discloses his private information like SSN, Address, Bank Details privacy is highly essential.

When dealing with web services, users need to give away their personal information through the application. Privacy is the right of individuals to determine for themselves when, how and to what extent information about them is communicated to others. It is a state or condition of limited access to information. In web services, this is concerned with the degree of trustworthiness with the web service provider. For web services to be successful, privacy must be protected. Today, privacy has become more important concern for both users and web service provider. More people will use web services if they feel all the information released is secure enough. Privacy can often be guaranteed through security measures.

To enable privacy protection for Web services, customers are allowed to specify their preferences about the disclosure of their information. The privacy preferences of a service are specified through WS-Policy. WS-Policy is a specification that allows web services to use XML to advertise their policies It represents a set of specifications that describe the capabilities and constraints of the security (and other business) policies on intermediaries and end points

Privacy is ensured during composition of the individual web services selected from the service registry according to the customer's requirements for the application e-governance involving Registration of Vehicles

The authors in [19] have not represented the privacy policies. Moreover, non compliances were simply reported and not processed further. However, the concept of Compliance checking addressed in [19] is adopted in our paper. The privacy policies were defined as rules in [20].However, our paper does not require the rule-based approach. We extend the concept of obligation generation and enforcement mentioned in [20].

Semantic based OWL ontology is used for privacy policy specification in [21].In our paper, as the policies are predefined, we use WS-Policy instead of semantic based approach The Hippocratic database mentioned in [22] represents privacy policies as metadata. However, we use WS-Policy instead of metadata and adopt the Registration of Vehicles application.

V. CONCLUSIONS

Composition of Web Services is gaining more importance as the needs of the user are ever increasing. For businesses to confidently compose their services with other business services, improving the trust among them becomes essential. Contracts make the business partners trustworthy. But contract generation can be time-consuming if done manually. Therefore, in this project, automated generation of contracts has been done for which an improved automated negotiation algorithm has been proposed whichensures highest satisfaction level of the providers as well as consumers. Multiple agreements are generated in a negotiation process and the best agreement is selected based on the satisfaction levels.

The agreed SLA between providers and consumers are generated as WSLA documents. WSLA is suitable for specification of SLO and SLA of functional and non-functional parameters. Contract establishment can only partially serve the needs of contract management if not linked to monitoring it. In this work, SLA monitoring has been effectively done and violations are logged. A template based approach has been used for dynamic composition of services. An SOA test bed which involves heterogeneous platforms and databases has been implemented.

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