

Towards an Advertising Business Model for Web Service Mashups

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ABSTRACT

On the Internet, the advertising business model is a cornerstone of many service businesses. In this paper, we propose an advertising business model for machine-oriented Web Services and describe the guiding principles for its mechanisms and implementation. It is not straightforward to make the advertising business method feasible for machine-oriented Web Services, since advertising only makes sense if the human users of a service see the ads. In the proposed business model, a non-human service consumer incurs an obligation to the providers of services it uses to display the advertising they have specified. In addition this obligation can be delegated to yet another service consumer if the later consumer is using a service provided by the earlier non-human consumer. Since each service provider-consumer chain must finally reach human consumers, the advertising from the earlier service providers will ultimately reach human service consumers, thus satisfying the conditions of the proposed business model. We also show how we can leverage the existing Web Service infrastructure to implement this business model.

Categories and Subject Descriptors

H.4.m [Information Systems]: Miscellaneous; D.2 [Software]: Software Engineering; D.2.8 [Software Engineering]: Metrics—*complexity measures, performance measures*

General Terms

Delphi theory

Keywords

Advertising business model, WS-Agreement, Web services composition, mash-up

1. INTRODUCTION

Designing a business model [29, 24] is a key factor for viable Web Service businesses using the Service-Oriented Architecture among multiple companies and individuals. However, the well-known utility business models [28, 26], where an entity consuming a service (the consumer) pays money to another entity providing the service (the provider), is often unsuitable for Web Service businesses using the Service-

Oriented Architecture among multiple companies and individuals.

In particular, in the context of businesses that are following the recent trend for the “Web as a participation platform” [23], it is becoming important to consider models such as advertising business models. In the world of the Web-as-a-participation-platform, the end users become content providers rather than just being passive consumers. Since end users often resist directly paying money for the services they consume, there is a call for some business model similar to the advertising business model, in which service consumers will not pay directly.

However it has not been straightforward to make an advertising-based model that is feasible for machine-oriented Web Services, because advertisements have no economic value if no human user of the service sees the ads. The situation would become more acute when they act as both service providers and consumers who “mash-up” services provided by others. The chain or stack of mashed-up services yields many service providers who cannot benefit from an advertising business model.

In this paper, we propose an advertising-based model for machine-oriented Web Services and provide guiding principles for its mechanism and implementation. In the proposed business model, a non-human service consumer is obligated to its service providers to eventually display the advertising they have specified. In addition, this obligation can be delegated to another service consumer if the later consumer is using a service provided by the earlier consumer. Since each service provider-consumer chain eventually reaches human consumers, the advertisements from the service provider will reach humans to fulfill the conditions of the proposed business model.

We also show how to leverage the Web Service infrastructure, especially WS-Agreement [22, 16, 5], to implement the business model. We show our proof-of-concept prototype implementation for the business model. In contrast to typical scenarios described along with WS-Agreement, not a service provider but a service consumer takes the initiative for a contract agreement.

The rest of the paper is organized as follows; First in Section 2, we motivate our proposal by showing a concrete example with a Web Service composition scenario to illustrate the problem for advertising business models. Then we propose our new advertising business model for composable Web Services in Section 3. Section 4 denotes how we can implement the proposed business model based on existing standards. After discussing related work in Section 5, we

conclude the paper in Section 6.

2. WEB SERVICE BUSINESS MODEL

In this section, we illustrate the problematic situation addressed in this paper. After showing a motivating example, we define a simplified Web Service business model that we assume as the basis of our proposal.

2.1 Motivating Example

Let us assume that there are service components as follows.

- **Address** search service – This service looks up the address of a given geographical location. For example, given the name of the location “Roppongi Hills” (a prominent Japanese building), it returns “6-10-1, Roppongi, Minato-ku, Tokyo”, which is the address of the location.
- **Nearest Train Station** search service – This service finds the nearest train station for a given address. For example, given the address “6-10-1, Roppongi, Minato-ku, Tokyo”, it returns “Azabu-juban”, which is the name of the station nearest from the given address.
- **Transit Guide** service – This service finds the best train route (or alternative routes) between two given train stations. For example, given train station names “Azabu-juban” and “Chuo-rinkan”, it returns the route “Azabu-juban, Aoyama Itchome, Shibuya, and Chuo-rinkan.”

Using these services, one can provide a new service, **Spot-to-Spot Transit Guide** as follows.

- **Spot-to-Spot Transit Guide** – This service finds the best train routes between two geographical locations with given names.

The new service combines these three services. Given two locations, it looks up the address of each location using the **Address** service. After finding the nearest train station for each address using the **Nearest Train Station** service, it obtains the best train routes between the two stations by consulting the **Transit Guide** service. The service then returns the routes to the original service consumer. The composite service can be accessed by a human user through a user interface using a Web-based application such as a Servlet subclass in Java Servlet Container, JavaScript included in a webpage, or a PHP script. In other cases, the new service could act as a component of other composite Web Services. Figure 1 depicts this Web Service composition example using a Java Servlet implementation for the user interface.

To obtain some revenue as compensation for providing services, the advertising-based approach is an attractive business model. Instead of letting Web Service consumers pay money directly for a Web Service, the service provider obtains money from advertisers or from an ad agency in return for displaying ads in the user interface website. In the real world, Google’s Custom Search Engine [10] and AdSense for Feeds [9] are the typical examples of this kind. For our **Spot-to-Spot Transit Guide** Web Service, the service provider can exploit the advertising business model. The providers of the

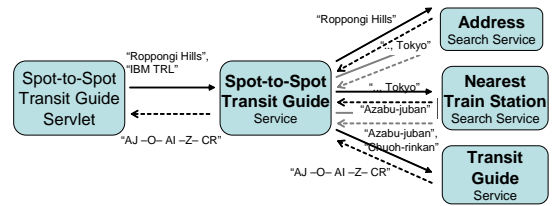


Figure 1: “Spot-to-Spot Transit Guide” Web Service Composition Example.

component services also supply the consumers of their services with some HTML text to access these services. Then they require the website users (using the human interface) to use the supplied HTML components to access their services on the website. These HTML snippets display ads in addition to the user interface to the backend services, and this generates income for the Web Service providers.

However, if the Web service is not directly consumed by a user interface then the website can not benefit from this business model. Since the consumers in such a case are not human users, the providers of the composite service cannot display the ads for the providers of the component Web Services. In our example, the **Address**, **Nearest Train Station**, and **Transit Guide** services cannot benefit from the advertising business model in our scenario. The only way for these services to exploit the advertising model would be if they were directly used by the user interface providers in a way similar to the Servlet Web application in our example.

2.2 Definition of Service Unit

In this paper, we discuss a simplified model of Web Service activities to clarify the proposed business model. A single unit of our service activity is completed as a pair of one request and the corresponding response in this simplified model. The service consumer sends a request message to the service provider, and then the provider performs some service action to return a response message to the consumer. For example, we could compare it to a stock quote service, which is one of the most typical examples of Web Services. A service consumer sends a query message with a stock symbol such as “IBM” to the service provider, and then the provider returns to the consumer the current price of the specified stock. A single unit of the stock-quote service activity is completed through this two-way messaging.

The definition of a unit of a service in this paper thus follows the definition of the term *operation* described in the specification of WSDL [4]. However, we focus only on the request-response transmission primitive out of the four transmission primitives described in the WSDL specification, since we can abstractly model the other operation types by using request-response messages.

2.3 Basic Web Service Business Model

The participants in our basic Web Service business model, as depicted in Figure 2, can have the following 4 roles.

Human User – A human who is an ultimate service consumer and who benefits from the provided services by using a Web browser.

Frontend Service Consumer – An ultimate machine-oriented

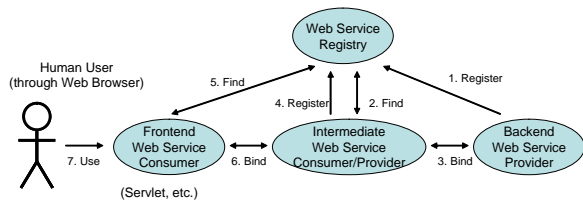


Figure 2: The basic Web Service business model.

service consumer who is not human, but which serves a Human User by providing a graphical user interface to the backend Web Services.

Intermediate Service Provider/Consumer - A machine-oriented service provider that also consumes backend Web Services. Note that a participant of this role may serve and consume from other participants with the same role, making service provider-consumer chains.

Backend Service Provider An ultimate service provider who doesn't rely on any other Web Services. This role is a specialized type of the Intermediate Service Provider that doesn't consume any Web Services.

The question we address in this paper is how the service provider can make money from providing a service that is not directly used by human customers. One of the popular business models is to just extend the original business of an enterprise so that it can provide an additional interface to the Web Services for its customers or business partners. The additional service itself in this business model is freely available for use. The enterprise providing that service doesn't make any money directly, but does make more money from its original business as a result of providing the service for the additional non-human users. This kind of business model is very solid and sometimes used by companies like e-Bay and Amazon. However, this approach is only applicable to limited types of companies and services.

An alternative business model that would allow a service provider to directly make money by providing a service is desirable for other types of services. For the Internet, researchers have been identifying possible business models based on existing practices [2]. Rappa, on his website, is publishing a categorized list of business models used on the Web [27]. While it continues to be revised, as of the current date of this paper, the categories include: Brokerage, Advertising, Infomediary, Merchant, Manufacturer (Direct), Affiliate, Community, Subscription, and Utility. The e-Bay Web Service business model is an extension of their business model categorized in Brokerage, while the Amazon model is an extension of the Merchant model.

3. ADVERTISING BUSINESS MODELS

In this paper we explore an application of the business models in the Advertising category in the terms of Rappa's classification [27], to component Web Services. Researchers in the area of utility computing [28] usually assume the use of business models similar to those classified in the Utility category. This type is known as the pay-as-you-go style and is the most intuitive model for making a profit from a service. For viable Web Service businesses using the Service-Oriented

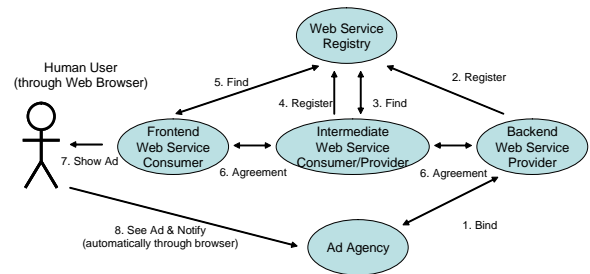


Figure 3: The proposed advertising business model for composable Web Services.

Architecture among multiple organizations and individuals, however, we believe that the advertising business models are worth exploring in addition to the utility business models. This is because the advertising business models have been a cornerstone of many business models on the Internet [2].

3.1 Propagated Ad Obligation

While ordinary Web Services with the advertisement business model let a service consumer take a responsibility to show the requested ads on its user interface, we let a service consumer take a responsibility of either:

- Showing the ads on its user interface similarly to the ordinary responsibility, or
- *Shifting the responsibility* of the advertisement to further machine service consumers.

Figure 3 depicts the proposed advertising business model for composable Web Services. In the business model, the advertisement for a component service (Backend Web Service Provider in the picture) would be displayed to a human user in the following steps:

1. **Bind** A component service (Backend Web Service Provider) makes a contract with an ad agency (Ad Agency).
2. **Register** Backend Web Service Provider publishes its service at a service registry (Web Service Registry)
3. **Find** A composite service (Intermediate Web Service Consumer/Provider) looks up its component services at Web Service Registry.
4. **Register** Intermediate Web Service Consumer/Provider publishes its service at Web Service Registry.
5. **Find** A user interface servlet (Frontend Web Service Consumer) looks up its backend service at Web Service Registry.
6. **Agreement** Frontend Web Service Consumer makes an agreement of an ad contract with Intermediate Web Service Consumer/Provider, who also makes an agreement of an ad sub-contract with Backend Web Service Provider.
7. **Show Ad** Frontend Web Service Consumer embeds the ad under the contract in the service user interface HTML and sends it to its client (Human User) through his/her Web browser.

8. **See Ad & Notify Human User** (potentially) sees the ad displayed by his/her Web browser and the Web browser automatically notify it to Ad Agency.

While Figure 3 only illustrates the business model profiting the Backend Web Service Provider, the same mechanism should be applied to other component services (Intermediate Web Service Consumer/Provider in the picture) as well.

3.2 Service Use Term Composition

In the propagated contract model, we need to handle the composition of service use terms. This is because a composite service may consume multiple component services who need service consumers to agree with the propagated contracts. For the example of “Spot-to-Spot Transit Guide”, the **Spot-to-Spot Transit Guide** service is composed from three component services each of who has the requirement of advertisement. Moreover, a composite service may want to add its own service use term, which may also be a contract to be propagated. Within the same example, we can offer the **Spot-to-Spot Transit Guide** service with advertisements.

For formally describing the use term composition for a service S , we represent the service use term declaration $UseTerm(S)$. If a composite service S consumes component services SS_i where $i = 1 \dots n$, we have the following equation:

$$UseTerm(S) \equiv BaseUseTerm(S) \wedge UseTerm(SS_1) \wedge \dots \wedge UseTerm(SS_n)$$

Here $BaseUseTerm(S)$ indicates an additional advertisement obligation for the composite service S , which corresponds to the virtual price of the value addition by the composite service. To say intuitively, the consumer of the composite service S takes the responsibility of the advertisement for the service S and its component services SS_i .

Note that a use term condition ($UseTerm(S)$) is defined with the use term conditions of its component services ($UseTerm(SS_i)$). This allows the delegation of advertising responsibilities along with the whole service provider-consumer chains, by shifting the responsibility from any service provider to certain ultimate service consumers at the end of the chain.

3.3 Advertisement Units

In this paper, we handle so-called display advertising, which is the special type of possible advertisement on the Internet. Display advertising is a type of advertising that contains text and graphic information such as messages, logos, photographs or other pictures. Periodically, it can appear on the same page with general Web contents. Display advertising typically uses static and animated images in various sizes called web banners or interactive media like applications of Adobe Flash. For the rest of paper, we refer Web banners as the display advertising on the Web as interactive media can be regarded as a special version of Web banners.

Web banners are usually available in standard sizes so that Web content providers can design the layout of the whole Web page including Web banners. An ad agency under the contract of paying a content provider for the displayed advertisements supplies the ad content of the size specified by the content provider. For example, Interactive Advertising Bureau specifies Web banner sizes like 468 by 60 pixels for a full-sized banner and 234 by 60 pixels for a half size banner in its guidelines [13]. An advertising Web content provider

```
<Advertisement xmlns="uri:ads">
  <ImageSource ref="http://www.company.com/ads1" />
  <PixelSize size="234x60" />
  <Appearance percentage="10" />
</Advertisement>
```

Figure 4: An Example Specification of an Ad Unit.

notify its ad agency of, to say, its expectation of the full size for Web banners in the layout of its Web page. Then, the ad agency supplies one of many ads of the size provided in advance.

For an ad unit to be used in a composing manner, we consider the probability of the ad appearance in addition to the size of the ad. It is the percentage number of statistics in which the content provider has to display the ad under the contract. For example, given the number of 10 percent, the content provider can go without the advertisement or with other advertisement for the rest 90 percent of its activity.

Figure 4 is the specification of an example ad unit. This description is shared between the provider and the consumer of a Web Service. Making an agreement of this advertisement contract means a service consumer takes the responsibility of directly or indirectly displaying the specified ad on the ultimate end-consumer, which is a Web browser in front of a human user. Once agreed, the ultimate service consumers must show the ad image obtained from the source specified by the `ImageSource` tag, which is of the size 234 by 60 pixels specified by the `PixelSize` tag, for the frequency of 10 times in 100 times service usage.

4. IMPLEMENTATION BASED ON STANDARDS

This section describes how the proposed contract propagation model can be realized along with the existing Web Service infrastructure. First, we briefly describes the existing WS-Agreement specification [22], which is the base of the language describing the proposed contract.

WSDL Attachment

The publication of a Web Service with the proposed business model needs to involve the service contract policy specification. This can be achieved based on the standard WSDL using the WSDL Attachment mechanism. Then the WSDL specification of the service can be published through the public/private UDDI [20] or through a proprietary mechanism and protocol agreed between service providers and service consumers. For the proof of concept implementation, however, we used the REST style [6] implementation, where we assume service providers and consumers already share the interface to the service.

WS-Agreement

The Web Services Agreement Specification (WS-Agreement) [22] defines a Web Services protocol for establishing agreement between two parties, such as between a service provider and consumer. It uses an extensible XML language for specifying the nature of the agreement, and agreement templates to facilitate discovery of compatible agreement parties. The specification consists of three parts which may be used in a composable manner: a schema for specifying an agreement, a schema for specifying an agreement template, and a set of

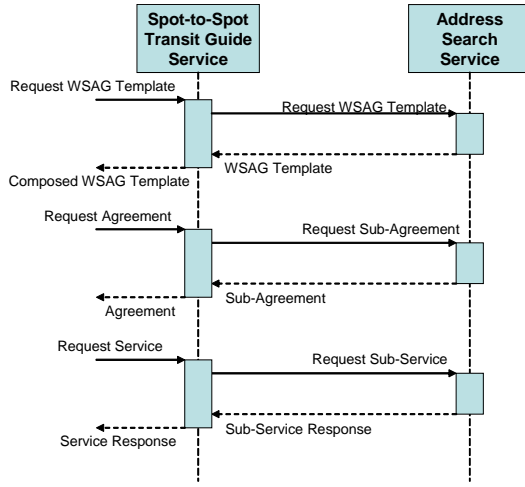


Figure 5: Interaction between a composite service and a component service with advertisement contracts based on WS-Agreement.

port types and operations for managing agreement life-cycle, including creation, expiration, and monitoring of agreement states.

Notably, in the advertisement contract creation process, a service consumer takes the initiative for a contract agreement. In the case of advertisement contract proposed in this paper, a service provider provides an agreement template, and then a service consumer retrieves the template and initiates an agreement based on the template. It is in contrast to typical scenarios described along with WS-Agreement, where a service provider offers agreements in the Utility business model with service level agreements [22].

WS-Agreement Usage

In the proposed business model, a service provider and a service consumer interacts to each other in 3 phases as shown in Figure 5. The 3 phases are of:

- WSAG (WS-Agreement) template passing before making an agreement,
- WSAG agreement request/response for making an agreement, and
- Actual service request/response.

In WS-Agreement, an agreement template is an XML document used by the agreement factory to advertise the types of offers it is willing to accept. Like an agreement document, the template is composed of a template name, a context element, and agreement terms, but additionally also includes information on agreement creation constraints to describe a range of agreements it might accept. Figure 6 is the pseudo WS-Agreement template generated by our prototype implementation of the Spot-to-Spot Transit Guide service discussed earlier.

We only make the limited use of WS-Agreement though WS-Agreement offers a rich language for stating the assurances and requirements of Web Services for capturing and representing the complicated nature of real world agreements qualifying conditions and business values. All agree-

```
<?xml version="1.0" encoding="UTF-8"?>
<Template xmlns="http://schemas.ggf.org/graap/2007/03/ws-agreement">

  <AgreementContext>
    <ServiceProvider>AgreementResponder</ServiceProvider>
    <ExpirationTime>2008-02-22T13:15:38+09:00</ExpirationTime>
  </AgreementContext>

  <Terms>
    <All>
      <ServiceDescriptionTerm Name="Address Search Service" ServiceName="AddressSearchService" />

      <ExactlyOne>
        <GuaranteeTerm Name="uri:S2STransitGS1" Obligated="ServiceConsumer">
          <Advertisement xmlns="uri:ads">.. Spot-to-Spot Transit Guide Service's Ad 1 ..</Advertisement>
        </GuaranteeTerm>
        ...
      </ExactlyOne>

      <ExactlyOne>
        <GuaranteeTerm Name="uri:AddressSS1" Obligated="ServiceConsumer">
          <Advertisement xmlns="uri:ads">.. Address SS's Ad 1 ..</Advertisement>
        </GuaranteeTerm>
        <GuaranteeTerm Name="uri:AddressSS2" Obligated="ServiceConsumer">
          <Advertisement xmlns="uri:ads">.. Address SS's Ad 2 ..</Advertisement>
        </GuaranteeTerm>
        ...
      </ExactlyOne>
    </All>
  </Terms>
</Template>
```

Figure 6: An Example WS-Agreement Template.

ments are written as a disjunction of alternative sets of guarantees which are expressed within the “GuaranteeTerm” tags. More detailed content of a guarantee term should form the one previously shown in Figure 4 or much more complicated ones, which is not implemented in our prototype and saved for the future work.

Frontend Web Application

Working code for a frontend web application is shown in Figure 7. It first makes an ad agreement by choosing the ad obligation that is most suitable to its layout design. Then it attaches the agreement key as a hidden input of the search form while embedding the obligated advertisement to its ad space.

Figure 8 is the screen capture of the browser rendering the service user interface and the advertisement. In addition to the Web form for using the “Spot-to-Spot Transit Guide” service, it displays ads for the Spot-to-Spot Transit Guide Web Service, the Address search Web Service, and the Transit Guide Web Service. The Web banner for Nearest Train Station search service is not displayed since the lottery for the ad drew blank that time.

5. RELATED WORK

Dynamic Composition

While we assumed one implementation for a Web Service interface [3] in the Web Service business model example, it is straightforward to extend the model to allow polymorphic implementations [3, 15, 30, 1, 8]. BaseUseTerm(S) for a service interface S can be defined using n variations of service implementation SI_i where $i = 1 \dots n$:

$$\text{BaseUseTerm}(S) \equiv \text{UseTerm}(SI_1)$$

```

<html>
<head>
  <title>Propads Example Frontend Web Application</title>
  <link rel="stylesheet" type="text/css" href="styles.css">
</head>
<body>
<?php
include_once("/var/www/lib/ads.php");
list($key, $ads) = select_ads("uri:s2sTransitGS", "468x120");
?>
<h1>Spot-to-Spot Transit Guide</h1>
<P>Enter two geographical spots for your navigation guide.</P>
<form type="GET" action="frontend2.php">
  <input type="hidden" name="key" value="<?php echo $key;?>" />
  <label>To:</label><input type="field" name="to_spot" />
  <label>From:</label><input type="field" name="from_spot" />
  <button type="submit">Search</button>
</form>
<?php echo $ads;?>"/>
</body>
</html>

```

Figure 7: PHP implementation of the “Spot-to-Spot Transit Guide” Web user interface application.

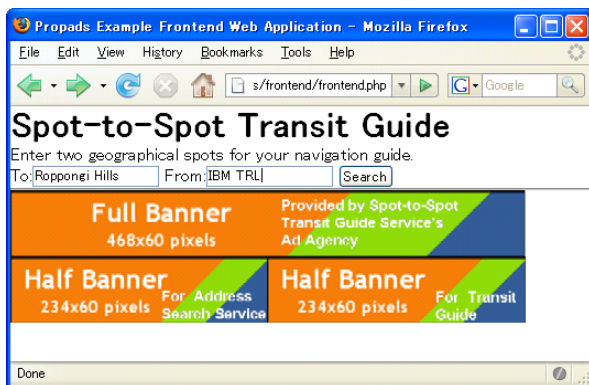


Figure 8: Screen capture of the “Spot-to-Spot Transit Guide” Web user interface application.

$$\oplus \text{UseTerm}(SI_2) \oplus \dots \text{UseTerm}(SI_n)$$

To say intuitively, the price of the composite service S is one of the prices of service implementations SI_i .

It should, however, involve more or less complexity due to the nature of the proposed agreement model. It is one of our future work to test and enhance the proposed business model in the presence of dynamic service registration [14], discovery [11, 7] and selection [32, 17]. For example, it is challenging to display appropriate ads on form user interfaces prior to the decision of component service implementation.

Semantic Web Services

For the prototype, we used the REST style architecture for implementation naively thus the service consumers and providers are tightly coupled. While we can imagine the world of vocabularies which are either standardized or ontologically mapped, it is interesting to employ semantic Web Service technologies in it. For example, compatibility of service contracts in service-oriented applications [19], a framework and negotiation protocol for service contracts [25], linking contracts, processes and services in an event-driven approach [18], semantic WS-Agreement [21], and so on, might be interesting to consider.

Policy Delegation and Propagation

In the domain of privacy, the delegation of privacy policies are required: the privacy policies have also to be enforced in a delegation and propagation situation. [12, 31] We can regard the propagation of policy enforcement as a special kind of contract propagation without agreement processes, to find some common requirements. Privacy, however, is usually applied to content data rather than services delivering the data.

6. CONCLUDING REMARKS

In this paper, we proposed an advertising business model for machine-oriented Web Services, which contributes to viable Web Service businesses among multiple companies, and especially, individuals. We described the guiding principles for its mechanisms and implementation based on the WS-Agreement standard.

While the proposed model and framework is just an architectural basis for the business model, we believe more interesting and complex contract models and advertising models can be built up on the proposed model. For example, the advertising model like lottery-based ads, as shown briefly in the paper, is indispensable for allowing a lot of composed Web Services to benefit ultimate human service consumers without “spamming” them.

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