

## *Service Intelligence for SOA and Cloud*

In this research path, we address the service intelligence in the service oriented environment with two types of solutions: i) smart decision support services, and ii) customizable generic agents at client side. The first solution is a new approach to service sophistication, where the users with no prior knowledge about a public domain's list of services can conveniently and effectively use those services without overwhelming the user with large lists of options and alternatives. Such a decision support service utilizes techniques from semantic analysis that are orchestrated through a new cloud-based concept namely "Consultant-as-a-service" that coaches the user to select the desired organization's business services and seamlessly connect them with the proper third-party applications (e.g., map, search engine, calendar, email, voice, video) in the user's mobile device. The second solution, offers an extension to SOA by adding a new component that we call "Service Representative" and a new web service that we call "task service". Service Representative is a software agent that stays at the client side and performs the assigned tasks from different service providers. Therefore, the client does not need to reveal its resources and its privacy and security are maintained and provides less network traffic. Task service is a multi-component (model, knowledge, data) web service that customizes the service representative and processes the client data locally at the client side.

### *Abstracts of Selected Publications*

#### **Consultant Services & Web Service Analysis**

##### ***Consultant-as-a-Service: An Interactive and Context-driven Approach to Mobile Decision Support Services***

Ahad Yarazavi and Kamran Sartipi

IBM CASCON Conference. November 18-20, 2013, pages 274-282, Toronto, Canada.

[\(PDF\)](#)

This paper presents a new generation of decision support services where techniques from software agents, semantic analysis, and data mining are orchestrated through a new cloud-based concept namely "Consultant-as-a-Service". The proposed concept will be offered as a set of new cloud application program interfaces that coach the user, who is not familiar with an organization, to effectively select the desired organization's business services and seamlessly connect them with the proper third-party applications (e.g., map, search engine, calendar, email, voice, video) in the user's mobile device (smart phone or tablet). Such consultant services can be provided for a variety of strategic business domains such as: banking, insurance, government, healthcare, and on-line shopping. A prototype mobile service has been developed using iOS for iPhone.

##### ***Identifying Distributed Features in SOA by Mining Dynamic Call Trees***

Anis Yousefi and Kamran Sartipi

IEEE International Conference on Software Maintenance (ICSM'11). Williamsburg VA, USA

Sept 25-30, 2011. Pages 73-82.

[\(PDF\)](#)

This paper proposes a new approach for identifying the implementation of web service features in a service oriented architecture (SOA) by mining dynamic call trees that are collected from distributed execution traces. The proposed approach addresses the complexities of SOA-based systems that arise from: features whose locations may change due to changing of input parameters; execution traces that are scattered throughout different service provider platforms; and trace files that contain interleaving of execution traces related to different concurrent service users. In this approach, we execute different groups of feature-specific scenarios and mine the resulting dynamic call trees to spot paths in the code of a service feature, which correspond to a specific user input and system state. This allows us to focus on the implementation of a specific feature in a distributed SOA-based system for different maintenance tasks such as bug localization, structure evaluation, and performance analysis. We define a set of metrics to assess structural properties of a SOA-based system. The effectiveness and applicability of our approach is demonstrated through a case study consisting of two service-oriented banking systems.

### ***Minimized Domain Knowledge for SOA-based Interoperability***

A. Dehmoobad and K. Sartipi

*IEEE Asia-Pacific Services Computing Conference (APSCC 2008)*

*Dec 9-12, 2008, Jiaosi, Yilan, Taiwan, pages 500 - 506*

[\(PDF\)](#)

The variety and heterogeneity of legacy systems at the application level have contributed to the complexity of interoperability provision among different application domains. In this context, most research activities are focused towards standardization and interoperability among the legacy systems within the same domain. However, an emerging challenge is to address the communication of information among heterogeneous legacy systems in different domains. The first step in achieving such a large interoperability is to follow similar development processes for collaborating domains, which provides homogeneity in their architectures. The second step would be to provide cross-domain semantic interoperability through proprietary and shared ontology systems. In this paper, we address the above challenges through description of a framework that employs healthcare standards and clinical terminology systems to achieve semantic interoperability between distributed systems in different domains. The main focus in our proposed framework is the minimal use of domain knowledge for cross-domain interoperability. Two case studies are provided, first we present how HL7 v3 is over-specified and then the proposed framework is applied to achieve semantic interoperability between two domains healthcare and insurance.

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**Client-side Web Service Processing using Customizable Agents**

### ***Modeling Service Representatives in Enterprise Systems using Generic Agents***

Mehran Najafi and Kamran Sartipi

*Journal of Service Oriented Computing and Application (SOCA). Publisher Springer,*

*Volume 5, No 4, pages 245-264, 2011.*

[\(PDF\)](#)

As a common practice in business enterprise systems, a service provider delegates a human agent to a client site to serve the client. On the other hand, in a computerized business application, enterprise organizations adopt Service-Oriented Architecture (SOA), where an enterprise agent is

modelled as a software agent that cannot be transmitted efficiently by service messages. In the proposed approach, we extend the traditional architecture of SOA implementations to support generic and lightweight agents that reside at the client site. These agents, that we call "Service Representatives", can be customized and trained based on the provider generated role description and knowledge to perform their assigned tasks. In addition to providing innovative applications, such a technique allows for more sophisticated features such as maintaining client privacy and separating the functionality of the service and its delegated agent. To indicate the variety of roles that can be done by the service representative, we provide three case studies to show how a local and generic agent can be customized by different providers to personalize financial advice, apply medical guidelines, and verify credit card transactions.

### ***Web Service Competition: A New Approach to Service Selection***

Mehran Najafi and Kamran Sartipi and Norm Archer

IBM CASCON 2012. Nov 5-7, 2012. Pages 161-175. Toronto, Canada.

[\(PDF\)](#)

As the number of web services that offer similar functionality increases, more sophisticated techniques for service discovery and selection will be needed. Traditional approaches compare web services based on their description published in service registries which include QoS and price/performance ratios, as well as adaptability. This information is generated by the service developer and may not be fully trustable by the client. Moreover, alternative services perform differently in different client contexts that cannot be determined accurately by service descriptors. In this paper, we propose a novel service selection approach that compares alternative services based on their performance in a specific client context. For this purpose, we extend the SOA infrastructure model through a component named the competition desk, that holds a competition among alternative services taken from the service client. As a result, clients can choose the service that works best for their needs.

### ***A QoS-Aware Decision Model for Web Service Development: Server side Data Services or Client-side Task Services***

M Najafi and K Sartipi and N Archer

IBM CASCON 2011, Toronto, Canada, pages 271-286

[\(PDF\)](#)

An enterprise system needs to provide different types of web services to model actual services in the corresponding business domain. We have proposed to categorize web services into data and task services. While a data service processes client data at the server site, a task service employs a service representative, as a generic client-site software agent, to process the client data locally at the client site. Task services maintain client privacy by locally processing client sensitive data and reducing the required network bandwidth. However, they limit the computational power of web services to the client platform. This paper proposes a decision model, which uses the analytic hierarchy process method to help service developers decide on the best type of business service for a specific functionality. The decision model includes evaluation functions for relevant quality of service (QoS) parameters. Finally, we use a case study to discuss alternative services and the decision making process.

## ***Virtual Remote Nursing System***

M. Najafi, S. Aghtar, K. Sartipi, N. Archer

*IEEE International Workshop on Consumer eHealth Platforms, Services and Applications (CeHPSA'11), Las Vegas, USA, pages 13-17*

[\(PDF\)](#)

This paper proposes a new framework, namely Virtual Remote Nursing (VRN) that provides a virtual nurse agent installed on the client's personal computer or smart phone to control the client's health condition continuously. In this approach, medical practitioners can assign different tasks to a virtual nurse using a generic task definition mechanism, where a task is defined as a combination of medical workflow, operational guidelines, and associated data. A VRN is controlled by the practitioners who decide on the patient's treatment. Therefore, a VRN acts as a personalized and full-time nurse for its client that performs the practitioner's tasks on the client's health information. Such patient information can be obtained from a Personal Health Record (PHR) system such as Google Health or Microsoft Health Vault. We have developed a prototype system that enables traditional client applications and healthcare provider systems to collaborate using a VRN system. Finally, through a case study, we demonstrate how diabetic patients can take advantages of this system.

## ***Client-side Service Composition using Generic Service Representative***

Mehran Najafi and Kamran Sartipi

Conference IBM CASCON, pages 238-252. November 1-4, 2010. Toronto, Canada

[\(PDF\)](#)

Traditionally, composition of web services is performed at the server-side. This requires transferring client data among collaborating web services, which may cause data privacy violation, security breaches, or network traffic overloading. In this context, we introduce the concept of "task service" which is a web service that can process the client data locally at the client-side using a generic software agent that we call "service representative". The proposed task service and service representative allow us to present a new concept called "client-side service composition", where collaborating web services employ the service representative to provide a composite task service at the client side. Therefore the client is not required to reveal its resources to service providers and hence its privacy and security are maintained. Moreover, large client data are processed locally that results in less network traffic. We have developed a prototype system for the proposed extended SOA model. Finally, we will discuss the advantages of the proposed approach over traditional server-side approaches using a case study in healthcare domain.