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Self-adaptability of real time service-oriented architecture to the context: Feasibility and case study

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***Abstract*—Real time impact in such applications is the subject of a recent field of studies in a information systems. Web services are a solution for the integration of distributed information systems, autonomous, heterogeneous and auto adaptable to the context. Thos impact can resolve many problems in different system based on SOA and web services. In this paper, we are interested in defining an approach to provide the different needs of a self-adaptability of SOA to context based on workflow, define the real time goal in our approach and showing the feasibility of this approach in an ambulance trajectory case study.**

Keywords— SOA; Web services; self-adaptability; real time; ambulance trajectory

I. INTRODUCTION

Ubiquitous computing [36] must meet some specific constraints surrounding self-adaptation to the context in real time in the systems based on SOA and Web services. Computing applications now operate in a variety of new settings; for example, embedded in cars or wearable devices. They use information about their context to respond and adapt to changes in the computing environment. They are, in short, increasingly context aware. Considerable approaches related to adaptability with different modes of implementation such as: Aspect Oriented Programming [15]. This aspect used by various platforms on the goal to adapt the Web service [39] to the context dynamic changes of environment. Web services, like any other middleware technologies, aim to provide mechanisms to bridge heterogeneous platforms, allowing data to flow across various programs. The Web services technology looks very similar to what most middleware technologies looks like. The emergence of Web services as a model for integrating heterogeneous Web information has opened up new possibilities of interaction and adaptability to context when offered more potential for interoperability. However, from a set of requirements on SOA (Service Oriented Architecture) [7], and to provide self adaptation to the context of Web services, we need to integrate more generic connector that takes into account all ambient or distant events in real time. The SOA offer great flexibility that is a great ability to functional and technical changes. Moreover, this type of architecture is most often used as Web services support, which provide the flexibility and interoperability expected, that is the ability to communicate between heterogeneous systems. The application in such information systems that incorporate SOA need to communicate across the exchange software (middleware or platforms). These middleware are the source of our work. It is on them that will think the same expectations in terms of flexibility, interoperability and adaptability.

The rest of this paper is organized as follows: In Section 2, we review previous research on adaptability of Web services, context awareness and real time impact in their approach. In section 3 we present our approach for a self adaptability of SOA to the context in the real time and the context awareness meta-model for them. In Section 4 we illustrate our solution by feasibility in ambulance trajectory case study. Finally, we summarize our work and discuss future research in Section 5.

II. RELATED WORKS

Context-aware systems [19] [20] [21] is the subject of a recent field of studies in pervasive computin. In [22] [23] [34], authors define context-awareness as the ability of a program or device to sense or capture various states of its environment and itself. In [13], the authors introduce another definition in which they insist on the use of context and the relevance of context information. In [8], the authors considered context is any information that can be used to characterize the situation of an entity. The authors give a general definition that can be used in a wide range of context-aware applications. In [37] the author approves this definition and claims that it covers all proposed works in context. However he considers it as a general definition that does not limit a context. Thus he proposes his own definition in which he limits a context in a set of information, which is structured and shared. It evolves and is used for interpretation. We stress that the notion of hierarchy (structure) of context introduced by [37] is important. The definition proposed in [6] also presents the

context as hierarchically organized. They thus define the context as the set of environmental states and settings that either determines an application's behaviour or in which an application event occurs and is interesting to the user.

Web service is the best fitted technology for implementing Service Oriented Architectures (SOA) offering flexibility and interoperability. WSs provide a minimalist mechanism to interconnect different applications. But one fundamental point is the importance of the WSDL [40] being the exact interface of the system. WSDL is responsible for the message payload, itself described with the equally famous protocol SOAP (Object Access Protocol) [27], while data structures are explained by XML (eXtended Markup Language) [41]. Very often, WS are stored in UDDI (Universal Description Discovery and Integration) [32] registry.

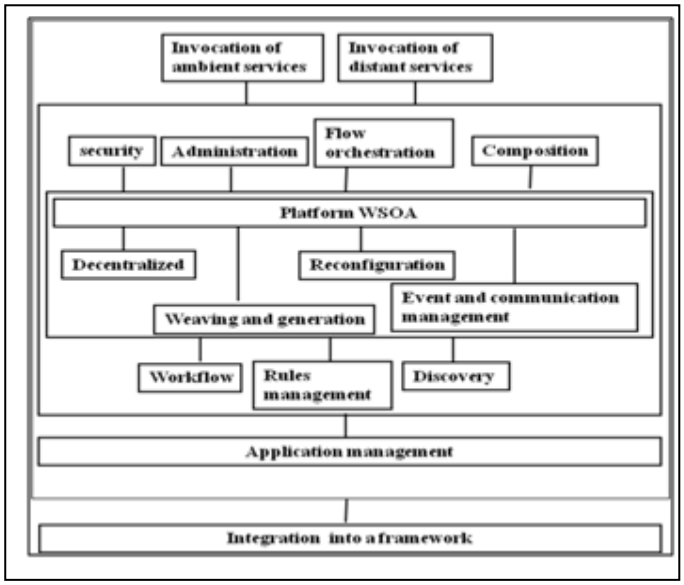
Many approaches treat the adaptability of SOA in joining with Web services, to context. Charfi and al. approach [5] propose a framework that provides support for middleware BPEL (Business Process Execution Language) [4] engines. The authors apply the concepts of deployment descriptor and container for the Web service composition. Ferraz Tomaz and al. approach [11] proposed a tool for weaving aspects for a simple adaptability of the Web services, implementing aspects of the services as loosely coupled, where aspects are woven dynamically. In this approach, aspects are themselves Web services, thus they are independent of languages and platforms. Ben Hmida M. and al., approach [2] extended the solution proposed by [11] to specify BPEL processes adaptable, that is to say, the adaptability of complex services. Hence the need to extend the semantic aspects and Web services, which resulted in the ASW (Aspect Service Weaver). Aspects are themselves loosely coupled Web services, they are independent of languages and platforms, but, this approach has limitations.

Adaptation to context is not taken into account, that is to say, if an event occurred during a search on a Web service, this approach does not take into account this event. In the other approaches we find those based on context adaptation [1] [3] [12] [24]. The ambient computing encourages the proliferation of associated devices. We cited WComp approach [28][29][30] which represents the implementation of experimental models for lightweight components for service composition SLCA (Service Lightweight Component Architecture) which enables the design of ambient computing applications by assembling software components, orchestrating access to services through infrastructure devices from ambient. WComp supports protocols such as UPnP (Universal Plug and Play) [33] and Web services, allowing components through the proxy to interact with them. To promote adaptation to context WComp uses Aspect Assembly (AA) paradigm. Aspect Assemblies can either be selected by a user or fired by a context adaptation process.

Several approaches have investigated the impact of real-time SOA. In [17], the approach supports the ability to publish and search prescriptive and descriptive metadata of services. The prescriptive metadata is the descriptive and domain-specific information about the functionality of a service. For instance, prescriptive metadata of a geospatial service could be the capabilities file describing the geospatial data presented by that service. RTSOA approach [31], presents a software infrastructure for industrial automation based on SOA for easing the problem of identification, discovery and communications among networked components, where the WSAgreement protocol has been extended in order to support attributes related to real-time and QoS of individual activities, to allow for the configuration of the system at run-time. In [16], authors carried out a demonstration project under iLAND [14] based on SOA to show the feasibility of challenge such when using real-time operating systems and networks. They used a relatively easy video streaming application that highlights the fast reconfiguration capabilities of the middleware iLAND.

In our research work [9][10], we presented a proposal to a self-adaptable SOA to the context based on workflow [38] by presenting the functional and technical architecture of our approach. In this architecture we have given different features in terms of the needs of self-adaptability offered by the integration of workflow, which allows the management rules [25] and a kind of security and administration of Web services. This solution which can offer management rules that deal with business logic. Business logic can help in the development and optimization of these assemblies separating the events produced by the components of Web services.

III. REAL TIME EVENTS IN A SELF-ADAPTABILITY OF SOA TO THE CONTEXT BASED ON WORKFLOW



A. *System design*

Fig. 1. System architecture for self-adaptability of SOA to the context

In figure (Fig. 1) we presented our research results based on the needs in terms of self adaptability of service oriented architecture to the context. This architecture is based on workflow when we can use the management's rules, when we aid to treat external and internal events in the context. Web services are a sometimes block not change as an access provider, which is why we integrate this rules in Web services block to change the behavior of Web services at an event to finally determine good self adapt these web services and then the SOA to the context. These management rules also provide us with real-time processing. The impact of real time is during extractions new needs and events not processed by Web services through well to technologies dedicated in the context.

Our architecture is based on objects or components to make the dynamic reconfiguration of components using more advanced mechanisms. It qualifies the distribution of applications across multiple servers and not the increase in service levels. There is a distributed architecture whose purpose is to deliver services to their audience and they will be accessible from any types of clients. Security and administration are offered by this system in treating the business logic from the workflow and rules.

Contextual resource discovery is the use of context data to discover other resources within the same context. The invocation of distant and ambient services is also permitted by this architecture using technologies dedicated to each type of invocation.

B. Feasability

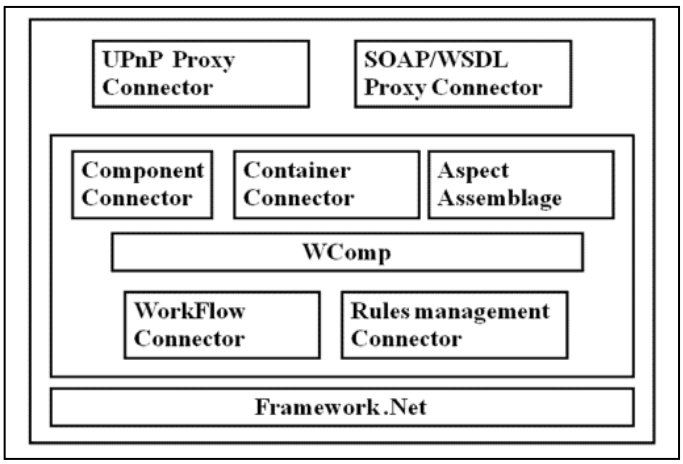


Fig. 2. WComp and workflow integration

This architecture (Fig. 2) allows the structuring of technical capabilities and infrastructure in our new approach WComp. In this architecture, except for the different needs initially used by WComp (service invocation ambient and remote data orchestration ...), we integrated connector's rules engine that communicates with a workflow engine in framework .NET. In this rules engine we need to define the rules that manage the data flow to finally produce events providing services to the customer.

The information shall be provided from a component that specifies the service to send it to another component by assembling them in a container through the language of Aspect of Assembly.

IV. AMBULANCE TRAJECTORY CASE STUDY

A. System design

The goal of our system (Fig.3) is to locate a destination chosen by the driver of an ambulance and give the shortest trajectory to that destination. The displacement of an ambulance at the accident site and from there to the nearest hospital is an operation of considerable importance for the treatment of emergency. Optimal trajectories correspond to the minimum required to transport. Find these links may take a considerable time in the case of large cities with very high density of road networks.GPS equipment is required to detect the position of the ambulance on his request and display the shortest trajectory to a definite destination. This will be achieved by the GSM or the Internet network. Also, other useful data as well as voice messages may be transmitted. Each ambulance will also be equipped with a computer or mobile data terminal (PDA, Ipad, Iphone ...) where we will install our system based on SOA and workflow end of a self adapt to the context and to display the requested trajectory. UPnP plug-in intercepts events coming from devices to send them to WComp that performs geo-localization of the destination. The Gateway links services to a set of points within an ambulance. This architecture is deployed locally or distant, inside the ambulance.

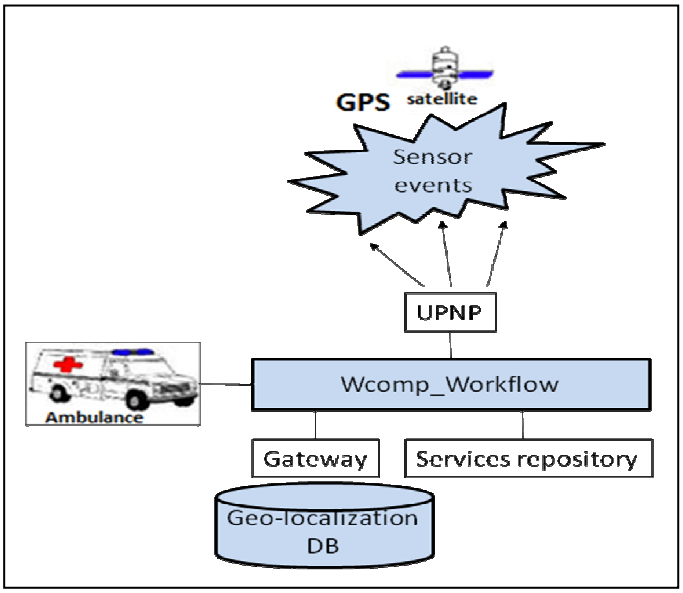


Fig. 3. Ambulance trajectory system

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Our system process spatial data cover the road network in real time. These data can be the location of hospitals and medical services, the positions of ambulances, the distribution of incidents in the past. Spatial data for the trajectory network contain intersections and segments of the trajectory. They form the framework for the definition of other features. Intersections are coded based on the type of intersection (eg crossing railway) and the type of control device current flow (eg stop sign, traffic light).

The data traffic will be very useful in our system. These data will be updated by processing traffic statistics and at the same time we must take into account the data received in real time resulting from traffic sensors installed on the road network. The traffic data will be stored in a data base. The data relating to events such as road works or events that also affect traffic will be provided by the municipality or the police. Data on hospitals, ambulances, and staff will also be stored in the data base to finally extract their availability in real time during an incident requests with a well-defined disease

B. WComp design

This design (Fig. 4) is due to container WComp. This container contains all components necessary to make the component with an assembly between them. We have made the connection between these components using the tool assembly AA. We used the WComp2.4 platform [26] version integrated in the tools of shapdevelop2.2 [35] development with the Microsoft .Net3.5 framework [18]. Under this version we can use business logic via the workflow engine. The component bean of WComp represents the different functionality necessary to invocate a different Web services.

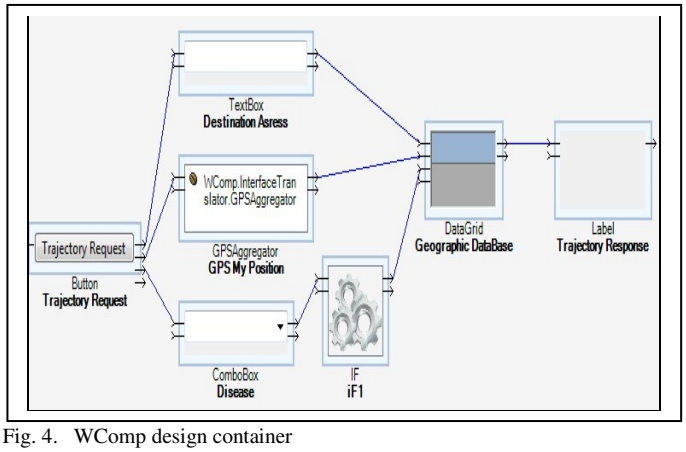

Fig. 4. WComp design container

We used the component button “Trajectory Request” to request the shortest trajectory between an input in the “TextBox” component “Destination Address” destination and current position in real time the ambulance detected by a GPS system represented by the component “GPSAggregator”. In the treatment of Web services offered by this component, we introduced the consideration of external and internal events on the track state, such as climate, bottling, lane road (one-way or two-way) season, road condition (broken or not). All this information is processed in real time through workflow and business rules using equipment and technology dedicated to import information about these events.

We also used a ComboBox “Disease” which adds additional information if the destination is a hospital to display the hospital has available service in real time. This service represents the staff responsible for this disease (doctors, nurses, equipment, operating room ...). We also used a geographic database represented by the "DB Geographic" components that can not only solve the problem of finding the shortest trajectory, but we have information about the condition of the trajectory. This goal is achieved by the calculated cost of different trajectories and chooses the shorter depending on its cost. We also added information regarding the availability of medical teams in hospitals.

To display the final result of our application, we used a label component “Trajectory Response” where we post with a link with other technologies that trace the trajectories as “Google Map”.

C. User interface

This figure (Fig. 5) represents the user interface of our application. This is a simulation of a request from the shortest trajectory between two points. Our system can detect the current position of the ambulance through GPS technology eg “Soukra”, and through a requested destination “Douar Hicher”. Our system will display results in the shortest trajectory using the specific technologies like Google Map.

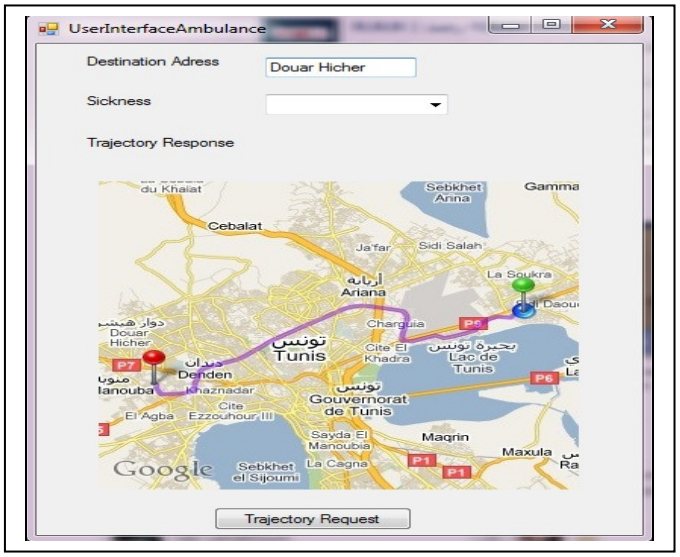

Fig. 5. Ambulance trajectory real time result

V. CONCLUSION AND FUTURE WORKS

We have shown in this paper the interest of self adaptability of Web services in SOA since it often involves multiple heterogeneous systems well as the real time impact in this system based on workflow. Real time impact can help us deal with the demands of Web services at any time and taking into account the internal and external events related to context which gives a self adaptability of SOA. We proposed also a context awareness meta-model approach whose goal is self adaptability of SOA to context. We have shown the feasibility of this idea and through modeling and implementation of ambulance trajectory case study. In future works, we aim to use methods and algorithms for calculates cost, as Dijkstra algorithm, to calculate the cost of trajectory based on internal and external events detected.

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