A Cloud Application Portal for the Maritime Industry

Bill Karakostas, Takis Katsoulakos
Inlecom Systems Ltd
London, UK
{bill, takis}@inlecom.com

Stelios Christofi
EBOS Technologies Ltd
Nicosia, Cyprus
stelios@ebos.com.cy

***Abstract*— We propose that enterprise portals and cloud management environments should converge, and that such convergence should take place from a user centric perspective. This paper describes the rationale, architecture and implementation of a system that provides user centred oriented integration of cloud applications. The novelty of the approach is that applications are not presented to the user in terms of their Cloud Application Programming Interface (API), but according to the users' task models. This gives the users fine grained control of the applications available to them independently of how they are delivered over the Cloud. We demonstrate the above concepts with a case study from the maritime domain.**

Keywords- Enterprise portal; Cloud portal; Cloud integration; Cloud API; maritime applications.

I. INTRODUCTION

An enterprise portal is an application that gives users a single point of access to other applications and information they need, with the ability to personalize the interface and content as they wish. In this way, a portal can help users make faster, more informed decisions. New generation of enterprise portals are geared toward supporting applications that are hosted in the cloud. In other words, enterprise portals are evolving from information gateways into all-purpose Web platforms that support a wide range of business processes.

The challenge in developing Cloud portals lies in the ability to integrate diverse cloud services into a single user environment that preserves the users' effectiveness to carry out tasks under their domain of expertise, by virtualising and integrating the APIs of diverse cloud services. Current cloud management environments do not support that, assuming the users' familiarity with the API of the cloud application/service.

The system illustrated in this paper integrates virtualised applications in a cloud environment. Applications running on heterogeneous clouds can be accessed from a single portal through a virtualised interface that corresponds to the user domain tasks.

The described system has been developed specifically for the needs of the maritime industry. However, the concepts and approach are equally applicable to other industries that utilize Cloud environments such as retail, finance, and other service operations. The structure of the paper is as follows. The next section surveys the state of the art in enterprise portals and cloud management environments. Section III discusses the research challenges and architecture of the proposed approach. Section IV presents a prototype that applies the proposed approach to the maritime application domain. Finally, section V discusses future plans for further research and extensions to the proposed idea.

II. LITERATURE SURVEY

A. Enterprise Portals

Many enterprise portals today enable website and application development, document management and collaboration. Several portals now integrate with content management systems, or otherwise offer content management functionality and integration with mobile devices, rich media and social media. However, the external applications accessed by such portals, are increasingly been delivered as services on some Cloud, something that has been coined the *cloudification* of legacy applications in Yu et al [1]. Thus, the problem of integrating external applications into an enterprise portal environment, these days, equals to the problem of connecting to and integrating services delivered by heterogeneous clouds.

The importance of Cloud service management through portals has also been acknowledged by the European Union Information and Communications Technology (ICT) Research Programme, which has funded number of projects in the ICT space of APIs, mashups and marketplaces, such as projects Multi-Modal Situation Assessment and Analytics Platform (mOSAIC) and Morfeo 4CaasT.

B. Cloud Management Environments

Although there is some convergence towards the use of communication protocols, i.e. with Resource State Transfer (REST) over http been the preferred method, and, less frequently, Simple Object Access protocol (SOAP)/Web Service Description Language (WSDL), as an alternative method), cloud computing services have diverse APIs through which they can be accessed. A unified interface to provide integrated access to cloud computing services is non-existent, currently. Thus, integration of cloud services into a unified web-based user interface must be carried out by the portal. Virtualisation technologies have a significant role to play towards this goal. Not only the Cloud services

 ISBN: 978-1-61208-388-9

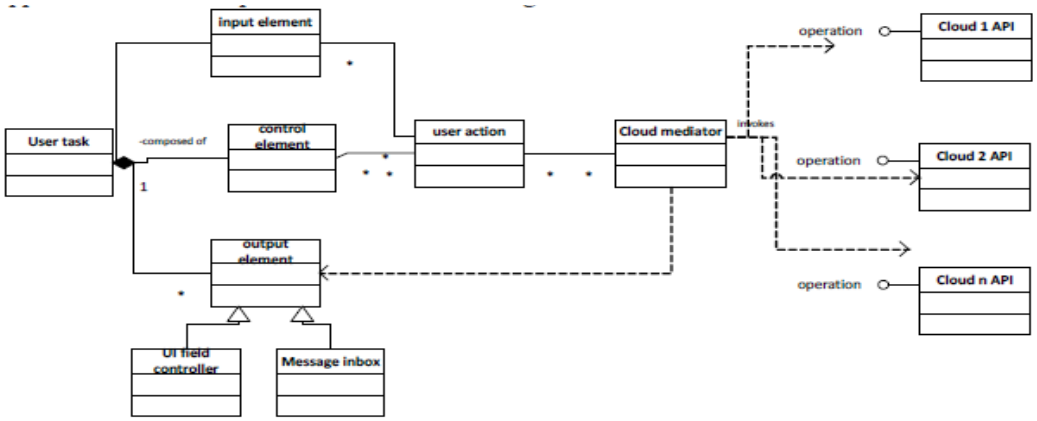

Figure 1: Architecture of mediator-based virtualization of cloud services

virtualise the computing environment, but the portal must provide a user oriented virtualisation environment for the service interfaces. This will virtualise the service interfaces in terms of sets of tasks commonly performed by the user. Some research towards personalized user environments already exists. For example, a paper by Zhang et al [2] presents such a system for Windows based on user-level virtualization technologies. At run-time, the user applications stored on a portable device run in a user-mode virtualization environment where some resource (registry, files/directories, environment variables, etc.) accessing APIs are intercepted and redirected to the portable device as necessary.

Users can access their personalized applications and data on any compatible computer, without the applications actually been installed on that computer. Cloud management environments as proposed in Alrokayan and Buya [3] place emphasis on ease of use, however not necessarily at the user task level, by providing a single point from which the user can control different cloud environment. For example, the Simple Heterogeneous Inter-Cloud Manager (SHINCLOM) project by Powell et al [4] is a prototype web-based single sign-on inter-cloud management portal that gives users the ability to easily configure and launch inter- architecture cloud applications and services. However, most current approaches do not adopt user task oriented strategies for cloud service management. Thus, we propose that enterprise portals and cloud management environments.

III. ARCHTECURE

A Research challenge

The main research challenge in this project is how to integrate heterogeneous cloud environments into a unified portal, in a user centric fashion, as per Gmelch's proposal [5]. The aim is to present applications to the user not according to their native Cloud APIs, but according to the user's task model. This gives the users fine grained control of the applications available to them, independently of how they are delivered over the different Clouds. In contrast, our approach virtualises the cloud application's API in terms of the user's task model. Thus, the user interacts with the Cloud application/service through a virtual API that is converted on the fly to the native API of the application. The approach is explained in the following sections.

B Application Integration Patterns

In this research, we opted for a mediator based integration approach, as per Hohpe and Woolf [6], as this allows the mediation between what the users perceives as the characteristics of their tasks, and what the cloud services offers to them through their APIs. The matching between the two (as well as any mismatches) is handled by the mediator. A task analysis method is used to identify tasks the user performs in the context of an application, the inputs output and control elements to the tasks. The modelling of tasks identifies the information elements that need to be provided by the application. A mapping is performed of the user task's input output and control elements to the Cloud application's/service API operations. As illustrated in Figure 1, the portal's mediator matches user actions and user visible content to the input and output parameters of the external cloud service. At runtime, the mediator will collect user input, convert it to the corresponding API operation and submit to the Cloud service. Depending on the style of interaction (i.e. synchronous vs asynchronous), service response will be mapped to the output user interface elements and immediately displayed to the user, or collected as a message to be delivered to the user's inbox.

C .Dynamic User Interface-Synchronous Communication

In this option, the Cloud application/service has to operate in a synchronous mode. The portal administrator configures the endpoint universal resource locator (URL) of the service. When a user wants to utilize the application, the Portal is responsible for dynamically creating a user interface, using the cloud service interface description (WSDL), and return to the user a data entry form to be used for the interaction with the service. Thus, communication

 ISBN: 978-1-61208-388-9

with the service is synchronous and the response to the user is presented immediately after the submission of the request.

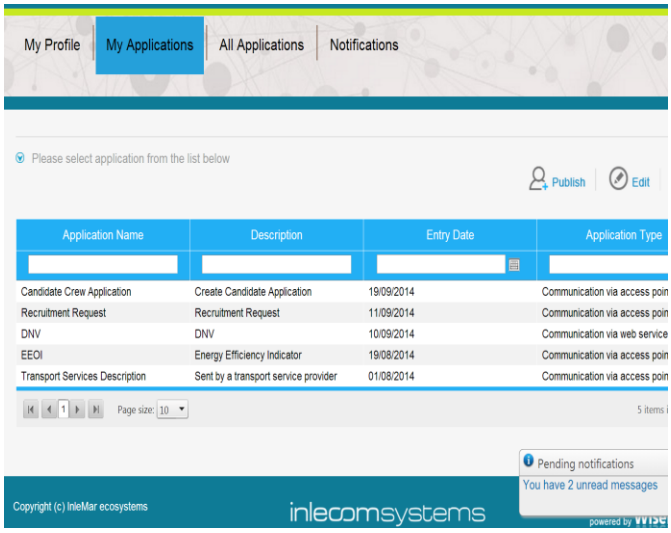

Figure 2: List of user applications

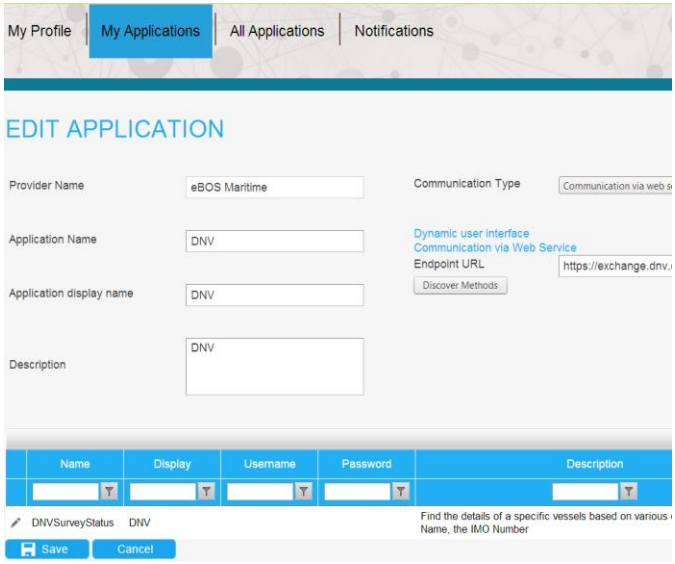

Figure 3: Application configuration by the portal administrator

D.Dynamic User Interfaces-Communications through Access Points

In asynchronous communications, the portal provides a messaging facility to allow users to communicate with the Cloud application. The portal also provides a message queuing facility for applications to exchange messages with the portal. The portal's messaging system handles in-order and exactly-once delivery, required for a consistent and complete presentation of service response messages to the users' inboxes. The portal administrator configures the XML Schema (XSD) of the message that will be exchanged and also how unique identifiers will be generated for its message.

When a user invokes the cloud service, the Portal dynamically creates a user interface using the provided XSD, and returns to the user a data entry form to be used for the interaction with the service. When the service returns a response, a notification is presented to the user's workspace environment.

User applications are configured by the portal administrator who specified the user visible parts of the application as well as the characteristics of the external cloud service (Figure 3). This allows user interfaces to be auto-generated as shown in Figure 4.

IV. PROTOTYPE

As explained already, the emphasis of the described prototype portal is on user centricity. Each user is given a set of applications to work with, organized into categories that are intuitive in the user's domain (i.e. maritime) and role specialization (for example, as recruiter of ship crew). Every time users log in to the portal they are presented with the list of available applications, as shown in the screenshot of Figure 2. With a single sign on to the portal, users can access all applications assigned to them. From their home page, users also have the ability to search for a particular application based on various fields such as the application name, description etc. Moreover, users can customise their view of existing applications. As shown in Figure 2, the users receive notifications from applications they have invoked in an asynchronous manner.

As illustrated in Figure 4, users interact with the external application through an auto-generated interface. In the screenshot of Figure 4, the user accesses an external service that selects ship crew that meet certain criteria. User input will be automatically converted to the expected API parameters of the external Cloud service. All user interface elements (labels and field values) in the above example are generated automatically from the user task model.

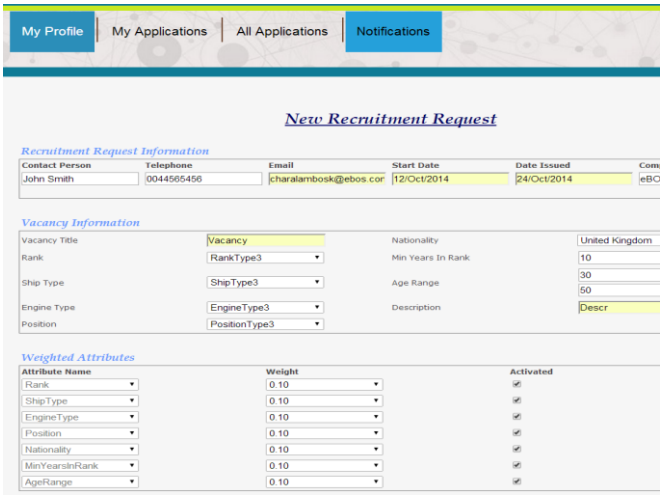

Figure 4: An end user application with a dynamically generated interface.

V. CONCLUSIONS AND FURTHER WORK

Shipping oriented portals are web-based communities which allow customers, intermediaries (e.g. forwarders) and carriers to communicate through a single portal for booking, tracking and tracing, documentation functions, etc. However, these portals offer a fixed set of functionalities and interfaces that assume specific user tasks. The approach described here presents several business and technical benefits, over them. With portal interfaces that adapt to user tasks, training costs can be significantly reduced, as the users do not have to learn the interface of several new applications. User satisfaction also improves, as the users feel comfortable in using applications whose interface matches the tasks they carry out in their domain of expertise. As new Cloud applications and services in a particular domain, emerge the users can access them seamlessly while maintaining a consistent interface.

However, there are also some restrictions in the current prototype and further areas of possible improvement. For start, a one to one mapping between a user task and a Cloud application/service is assumed. It is also assumed that the user tasks are independent from each other, while in practice these tasks are often joined in a user oriented workflow. It would be desirable to allow users to specify not only tasks but process workflows as perceived by them. Ideally, this would have to be done via a graphical environment. Integration of external cloud applications/services into this workflow would had to be carried out by the portal, as the Cloud applications are by definition application/process agnostic. Thus, the mediation manager discussed in this paper would also have to become a workflow manager.

The next area of improvement concerns the portal administrator's development environment. This environment is currently form based, where the administrators are given options to configure user profiles as well as the profiles of the external cloud services and applications. Generation of dynamic interfaces and messaging communications are handled by portal's internal services. A fully fledged development environment, would allow portal developers and administrators more flexibility in configuring access and integration with external Cloud services and further customisation of the end user options. This could be achieved by a system level scripting language such as those used by other Cloud management environments.

ACKNOWLEDGMENT

Research reported in this paper was partially supported by the EU under Project eMAR (Grant Number 265851 DG MOVE).

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