A Case Study:
Mobile Service Migration Based
Traffic Jam Detection

M. Mohanned Kazzaz, Brno University of Technology, Brno, Czech Republic
Marek Rychlý, Brno University of Technology, Brno, Czech Republic

ABSTRACT

This article provides a proof-of-concept of the applicability and reusability of the authors proposed framework for web service migration through a traffic jam detection case study. The framework migrates mobile hosted web services between mobile vehicles using context-aware self-adaptive mechanism in order to guarantee service availability and quality. A decision-making process is implemented to select the best destination vehicle from between the found possible migrations based on prioritized criteria set.

KEYWORDS

Context-awareness, Mobile Host, Mobile Service, Service Migration

1. INTRODUCTION

Mobile service development and provisioning have become main focuses of nowadays researches because of the huge improvements in mobile device capabilities and the vast availability of wireless networks. As in the traditional Service Oriented Architecture (SOA) (Erl, 2005) researches, context-awareness (Abowd et al., 1999) and self-adaptation (Garlan, Cheng, Huang, Schmerl, & Steenkiste, 2004) have been the main approaches proposed to enable and leverage SOA capabilities in mobile systems (Papakos, Capra, & Rosenblum, 2010; Hoang; & Chen, 2010; Paspallis, 2008; Alkhabbas, Spalazzese, & Davidsson, 2017).

Service mobility has been proposed in ad-hoc networks to support services sharing and consuming on the fly between mobile devices (AlShahwan, Carrez, & Moessner, 2012; Wagh & Thool, 2014; Zuo & Liu, 2015). A service can be moved to perform location-based tasks (i.e., device tracking or search for surrounding devices), to process data on other devices and/or to temporarily use resources of available devices in the network (such as processing power or sensors). In order to enable service mobility between mobile devices, a shared semantic understanding between devices to express the status of their specifications and requirements. Additionally, it is required to provide a semantic description to define services specifications and properties. Contextual information such as location, speed, hosted services, and service description must be semantically presented and dynamically generated to provide a real-time information and status of the participating devices and services in the system.

The possibility of having several adaptation plans for a client’s service to move over a set of possible destination hosts requires a decision making process. This process provides the adaptation
system with a selection mechanism to decide where to migrate its service based on defined criteria that affect service quality and system adaptation in different levels.

In this work, we demonstrate a traffic jam detection scenario in peer-to-peer network as the proof-of-concept to the applicability of the Mobile Web service migration framework in Kazazz and Rychly (2017). The framework is proposed to enable service provisioning and migration in Mobile SOA by providing system adaptation to context changes of the mobile device resources. The provided case study presents the reusability of the demonstrated migration framework by adopting a traffic jam detection scenario and extending system ontology and decision-making process introduced in (Kazazz & Rychly, 2015).

This work is motivated by the traffic jam scenarios presented in (Riva, Nadeem, Borcea, & Iftode, 2013; Weyns, Malek, & Andersson, 2010) where the migration framework is installed on a group of cooperative cars. A car $A$, can plan its route from point $X$ to point $Y$ and investigate a traffic jam possibility on this route. The traffic jam investigation is performed through migrating TrafficJamSearch service of car $A$ and running it on another car $B$ (i.e., a new service provider) located in the area of interest (AOI) defined by car $A$. By calling the migrated service, car $A$ will acquire the required information in order to plan a better route by avoiding traffic jams.

In this example, there are two criteria governing the service migration decision making process:

1. SpeedCriteria: represents the speed difference between a subject car $A$ and the destination car $B$, and
2. CenterDistanceCriteria: represents the distance of destination car $B$ from the AOI’s center of car $A$.

The SpeedCriteria promotes the migration selection to destination car with the speed closest to the speed of $A$. While the CenterDistanceCriteria promotes the selection of service TrafficJamSearch migration to the car closest to the center of the AOI of car $A$.

When a car $B$ is chosen as a new destination for the TrafficJamSearch service, the migration controller on $A$ starts the physical migration process to $B$. Then, $A$ executes a search process on $B$ by calling TrafficJamSearch to discover the number of existed cars in $A$’s AOI in order to detect a traffic jam on its planned route. This work adopts the Internet of Things (IoT) approach through depending on a migrated service that is locally hosted on a mobile device instead of relying on an external cloud service.

The rest of this paper is organized as follows. Section 2 discusses the related work on context-awareness and related implementation on traffic jam detection. Section 3 presents the ontology-based context model provided to describe services and vehicles properties and preferences. Section 4 demonstrates the migration framework for mobile service migration between vehicles. Section 5 provides a detailed description of the framework implementation. Section 6 provides description of the experiment performed to test the context-aware mobile Web service migration approach through cooperative vehicles scenario. Finally, the researchers present the work conclusion in Section 7.

2. RELATED WORK

This section presents the related work utilizing context awareness and self-adaptation to solve traffic jam problems. It discusses the differences between these works and this one.

In (Feld, & Müller, 2011), the authors demonstrated an automotive ontology-based vehicle and user models to support knowledge sharing between cars and to allow system adaptation and recommendation based on user’s preferences.

In the work of (Hu, Li, Ngai, Leung, & Kruchten, 2014) context-awareness has been proposed to enable the usage of several resources of contextual data such as user’s personal activities, social data
A Model-Driven Approach for the Design and Implementation of Software Development Methods
Mario Cervera, Manoli Albert, Victoria Torres and Vicente Pelechano (2012). International Journal of Information System Modeling and Design (pp. 86-103). www.igi-global.com/article/model-driven-approach-design-implementation/70927?camid=4v1a

Segmentation Matters: An Exploratory Study of Mobile Service Users