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Tool-chain development for end-user composite services

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Problem Description

The task is to further develop and improve an infrastructure for end-user service composition. The existing infrastructure includes a service creation environment, service execution environment, and a calendar application. These various components exchange service composition descriptions specified in xml. The task includes the following sub-tasks:

1. Improvement of the integration between the various components of the infrastructure
2. Generalization of the xml representation of the composite services to be in-line with the EMF terminology
3. Development of end-user service composition profile support
4. Support for location-based service compositions
5. Improvement of the graphical representation of the service creation environment and the mobile terminal client
6. Simplification of the overall end-user experience regarding creating new composite services and tailoring existing ones.

The student will also implement new service components and work out new service composition scenarios. The focus will be on scenarios where calendar, location-based and telephony service components will interwork.

Abstract

Telephony has become an integral part in the day to day communication and new telephony services are quickly being deployed in the industry. There is a need for users to be provided with new services on the fly; these services can be composed from existing services to provide an added-value service. The vision is to allow ordinary people, who are the end users, to easily compose a set of available services and run them on their devices while they are on the move without requiring specialized IT or telecom skills.

An end user service composition approach is followed that reduces the composition complexity and difficulty from the end user perspective. The approach enables the end users to personalize the compositions with a powerful presentation and supporting the end users to dynamically customize the service composition.

A scenario based approach is followed whereby different practical composition scenarios are explored to shed light on several aspects of how the end users can personalize the composition process using the tool that has been presented by creating compositions that create added value services for the scenarios looked into.

Preface

This Masters Thesis is written at the Department of Telematics in the Norwegian University of Science and Technology (NTNU) during the Spring Semester, 2011. The project is submitted as a fulfilment of the graduation requirements of my Master degree in Telematics.

The theme of this project work was defined by UbiCompForAll - Ubiquitous service Composition for All users. UbiCompForAll is a research project founded by the Norwegian Research Council. The project involves SINTEF, NTNU, Gintel, Tellu and Wireless Trondheim. The focus being on end user service composition of telephony services, messaging services and other personal management services such as appointment organizer, calendar, customized search, location handling, reservation services, etc.

A part of this Master Thesis looks into work carried out previously in development of a tool that allows for end user service composition. Jens Einar in his Master's Thesis created the Easy Composer, which is a tool for end-user service composition. The easy Composer works with another tool the Easy Droid developed by John Edvard Reiten. During my Masters Project, I created the Easy Composer with calendar tool. After studying the set of tools, I extended the Easy Composer with Calendar to include a map, and added more components on the Easy Droid.

I would like to thank my Supervisor, Mazen Malek Shiaa for giving me good and comprehensive advice and guiding me through the project. In addition I would like to thank Jens Einar and John Edvard for their support and cooperation throughout my project work.

Frank K. Mbaabu

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1 Introduction

Service composition involves the development of added value services by allowing the orchestration of already existing services into an added value service which is needed at a particular instance. In this chapter we look into the background of service composition what it generally entails in section 1.1, at the same time looking at why service composition is of importance. Section 1.2, looks at the problem to be addressed and how this problem is to be solved. Finally section 1.3 looks at the structure of the report.

1.1 Motivation and Background

Mobile technologies have evolved rapidly in recent times, leading to the development of mobile phones with more advanced functionalities. The advances in mobile device design and fast progression of ubiquitous computing, have led to devices around a person providing services that users might want to use. The introduction of smartphones in the market has also revolutionized the telephony industry, whereby these technology-rich mobile phones act as a connection towards a universe of mobile services. These services include telephony services, personal management services, internet services as well as services pervasively located in the users' environment.

Telephony has become an integral part in the day to day communication and new telephony services are quickly being deployed in the industry. There is a need for users to come up with new services on the fly; these services can be composed from existing services to provide an added-value service. It is therefore highly recommended that the user makes use of this services made available with ease. However, the task of combining available services in order to fully exploit their potential in an integrated way is done manually or through the use of complicated standards such as WSDL, BPEL and many others, and this is becoming more and more difficult, and often a practically impossible task, for end users.

Service Composition involves the development of customized services by orchestrating already existing services into one or more new services in order to achieve certain objectives. Therefore service composition can make the task of integrating these services much easier. However, the current composition styles need professional expertise such as programming skills to achieve this.

End user service composition in this case allows for end users without this expertise to easily compose their own services. The vision is to allow ordinary people, who are the end users, to easily compose a set of available services and run them on their devices while they are on the move without requiring specialized IT or telecom skills.

1.1.1 Ubiquitous Computing

Ubiquitous computing also known as pervasive computing is the growing trend towards embedding microprocessors in everyday objects so they can communicate information [1]. Pervasive computing devices are completely connected and constantly available. In their research on the PARCTAB experiment Mark Weiser et al [2] believe that creating such an intuitive and distributed system requires communication and context. Communication allows system components to share information about the context. That is information about the status of the components and their environments.

Wireless technologies, advanced electronics and the Internet allow for the communication ubiquitous computing requires in converging the different devices. The goal of pervasive computing is to create smart products that exchange context information.

The ability to seamlessly compose the services from various devices in an ad-hoc manner is an important feature of ubiquitous computing

1.1.2 Service Oriented Computing

Service-oriented computing (SOC) focuses on utilizing services when developing applications. Its main emphasis is the development of rapid, low-cost, interoperable, evolvable, and massively distributed applications by code and application component reuse. In simpler terms it reflects a "service-oriented" approach to programming where applications are composed by discovering and invoking available services to accomplish some task. In addition this approach is meant to be independent of specific programming language or operating systems. In order to achieve this, application components should be assembled into loosely coupled network of services that can be used to create agile applications.

Web services are currently the most promising SOC based technology. They use the Internet as the communication medium and open Internet-based standards, including the Simple Object Access Protocol (SOAP) for transmitting data, the Web Services Description Language (WSDL) for defining services, and the Business Process Execution Language for Web Services (BPEL4WS) for orchestrating services [3].

1.1.3 Service Oriented Architecture

Service Orinted Architecture (SOA) packages functionality as a suite of interoperable services that can be used within multiple separate systems which in turn can be used from several business domains. SOA helps to realize service oriented computing.

The Figure 1-1 by Papazoglou and Georgakopoulos [3] shows the software oriented architecture pyramid. The basic services constitute the SOA foundation, while the higher layers in the pyramid provide additional support required for service composition and service management.

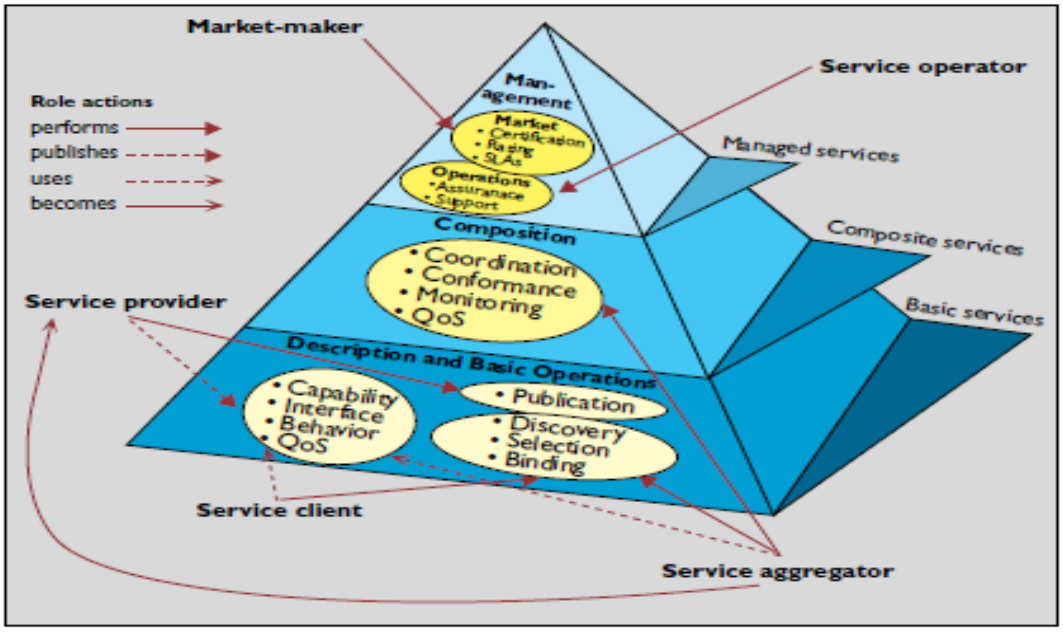

Figure 1-1 Service Oriented Architecture.

Papazoglou and Georgakopoulos further look at the different layers, their functions and roles which include [3]:

- The Basic services layer constitutes the SOA foundation. It offers the basic services, their descriptions, and basic operations on these descriptions, which are publication, discovery, selection, and binding.
- The service composition layer encompasses necessary roles and functionality for the consolidation of multiple services into a single composite service. The resulting composite services may be used by service aggregators as components in further service compositions or may be utilized as applications/solutions by service clients.

- The Service management layer provides managed services by managing critical applications/solutions and specific markets. SOA's operations management functionality is aimed at supporting critical applications that require management of the service platform, the deployment of services and the applications. Another aim of SOA's service management layer is to provide support for open service marketplaces.

1.1.4 Service Composition

Service oriented computing focuses on four related research themes: service foundations, service composition, service management and monitoring, and service-oriented engineering [4]. Services are autonomous, platform-independent entities that can be described, published, discovered, and loosely coupled. Service composition creates new customized services by discovering, integrating multiple services into a single composite service which in turn can be used as basic service in further service compositions or offered as service to service users.

Papazoglou et al [4] further define the process of service composition as having three phases:

1. The planning phase; where the candidate services are discovered and checked for compos ability and conformance.

2. The definition phase; which generates the actual composition structure.

3. The implementation phase; which implements the composite service bindings based on the service composition specification.

In their survey Laga, Bertin and Crespi investigate the different approaches of service composition [5]. They categorize mechanisms of service composition into: automatic service composition, semi-automatic service composition and static service composition:

- In automatic service composition the user formulates a request in natural or formal language and then the composition mechanism processes the request and generates the composite service.

- Semi-automatic service composition allows for the creation and management of composition by the end user through a graphical interface e.g. YAHOO PIPES or using a formal language.
- By static composition we mean a composition that is achieved by a person who has development skills and who knows the existing services. This person then builds a composed service with a programming language by invoking existing services.

1.1.5 End-User Service Composition

End user service composition is an initiative to bring the advantages of service composition to users who necessarily don't have computing skills. Despite the advantages only a small proportion of users can construct service-based applications as they require considerable modelling and programming skills. This limitation can be attributed to the complexity of the existing composition approaches and the limited technical knowledge of end users. Thus the challenge lays in simplifying service composition. Usman et al while working for the SOA4ALL project, identify three approaches aimed at simplifying service composition as outlined below [6]:

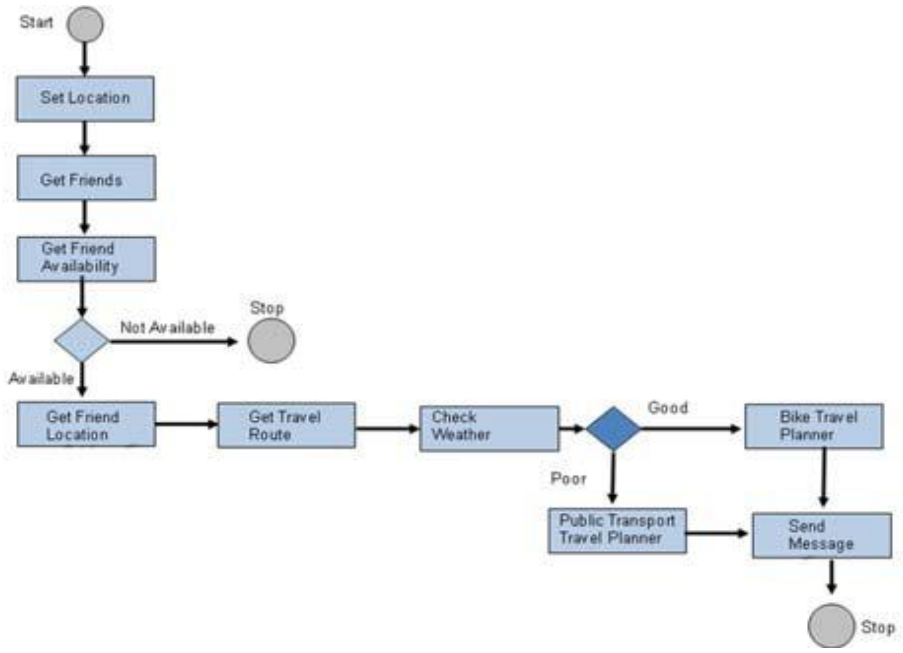

Figure 1-2 Control Flow-based Composition Approach.

Control Flow-based Composition Approach: this approach follows a sequential process when composing services, where by a service has to be completed before the next service is executed. In this approach what is of importance is the order in which atomic services are executed. Apart from the sequence the various useful relations between services are defined; these include unconditional branching, conditional branching, iterative execution and unconditional stopping. Figure 1-2 shows how the control flow-based composition approach works.

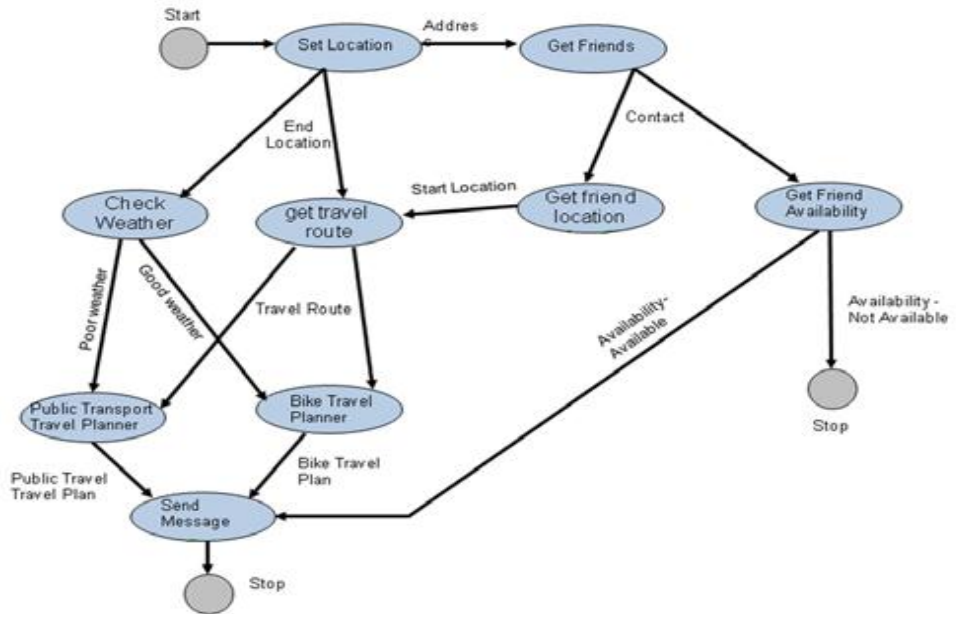

Figure 1-3 Data Flow-based Composition Approach.

Data Flow-based Composition Approach In this approach the focus is on the data passed between multiple services rather than the sequence. It can be looked at as an information-oriented view of service composition. This approach enables users to define how data flows from source service(s) to destination service(s) and does not consider the information about service execution order and conditions. Figure 1-3 shows how data is passed between multiple services.

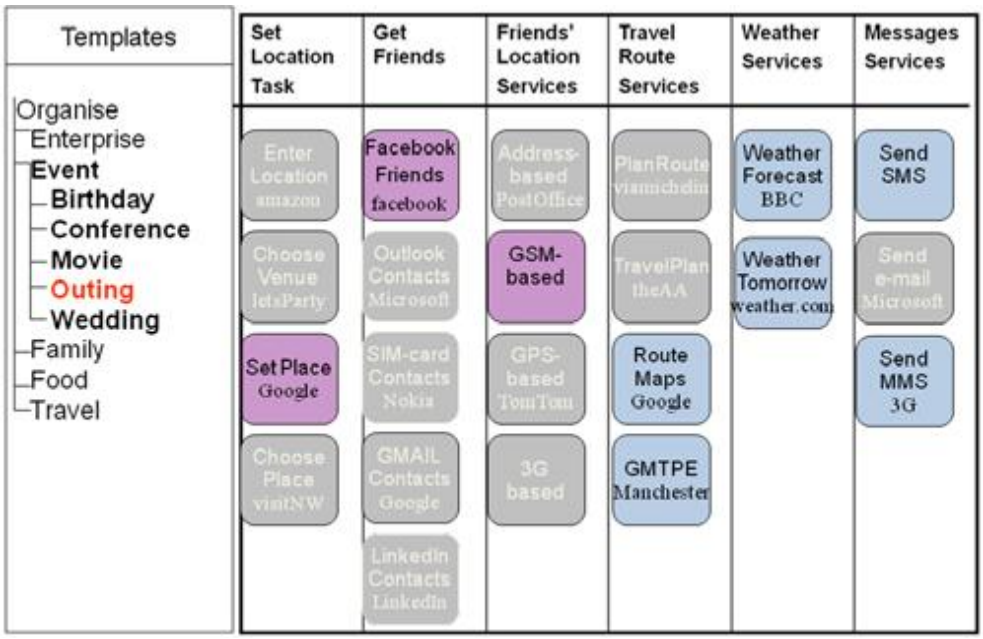

Figure 1-4 Assisted Composition Approach.

Assisted Composition Approach This approach is drawn from human computer interface design methods and principles, whereby users choose individual services from a wide range of available services in the composition template. In addition there is a computational algorithm that manages the interoperability and compatibility of services therefore the users can select from a wide range of customizable system templates and do not have to define control and data flow among services as these aspects are managed automatically. An example of the assisted composition approach is shown in Figure 1-4.

1.2 Problem Statement

Telephony has become an integral part in the day to day communication and new telephony services are quickly being deployed in the industry. There is a need for users to come up with new services on the fly; these services can be composed from existing services to provide an added-value service. The vision is to allow ordinary people, who are the end users, to easily compose a set of available services and run them on their devices while they are on the move without requiring specialized IT or telecom skills.

In traditional networks the user has to subscribe to the service offered by the network operator or services already pre-programmed in applications within the device. The user has no way of composing new services from the existing service and this makes it difficult for the user to coordinate the services offered in order to accomplish his/her particular tasks on the fly. Some technologies have emerged, such as the Easy Designer described in chapter 4, which enable for service composition but not at the end user level but by the operators.

Service composition is left to the service provider rather than the users who are in better position to define what they need. The intention is to allow the users meet their requirements by composing their own services, rather than using services offered by the service providers that are not fully tailored to their needs.

This added value will enrich the user experience. The users can take up services that are made available and orchestrate new services. The focus being on telephony services, messaging services and other personal management services; such as appointment organizer, calendar, customized search, location handling, reservation services, etc.

1.2.1 Challenges in End user service composition.

Since much of the service composition successes are based on web services, we consider the shortcomings of end user service composition based on these technologies. Some of the challenges that limit the end users from composing their services include:

Complexity in service description and discovery: The existing techniques for service description and discovery are too complex for users without programming and modelling knowledge. For instance the Web Service Description Language (WSDL) which is commonly used to define a service is usable only by SOA experts. In addition they also need to understand the interface and parameters of a Web service in order to correctly invoke it. This therefore makes it difficult for end users to understand the functionality required to discover a service when composing services.

Complexity in composing services: Once a service is deployed it also becomes difficult for end users to use the services in composing their own services as this will require technical skills that end users don't have. This is done by experts where they orchestrate services through the BPEL (Business Process Execution Language) which would be almost impossible for someone without this knowledge.

1.2.2 Existing End User Service Composition Approaches, Challenges.

In the quest to solve the above mentioned problem three end user service composition approaches are identified in the previous section 1.1.5. Even though these approaches have enabled end user service composition to some extent the following challenges still exist:

Control Flow-based Composition Approach: this approach has the advantage that it is easy to use as one follows certain logic when composing services. It also allows for flexibility in that logic can be created for many situations when the need arises. Also it can allow for compositions with many services.

The downside is that at times understanding the logic required for a particular situation maybe a difficult task as it somehow requires some modelling techniques. Additionally, due to the sequential nature of a control flow a composition involving various services can get too complex for users to keep track of.

Data Flow-based Composition Approach: data flow-based approach is highly flexible as it allows for composition of many situations.

On the other hand it is a difficult approach for non-programmers due to the underlying complexity of managing different data sources in that there might be a lot of inconsistencies of the data from the different sources. Moreover, modelling skills are required and modelling techniques such as the data flow diagrams may be needed when coming up with complex compositions. The complexity can also lead to composing services wrongly

Assisted Composition Approach: the assisted composition approach is an easy approach to use; it reduces the complexity of service composition by providing the user with a set of options that make it easy to compose services without any programming or modelling knowledge.
The limitation of this approach is its scalability and flexibility. For instance, one cannot customize or create their own compositions and extending the list of available services might be impossible. It also eliminates the ideology of service composition as it forces users to a service already created rather than allowing a user composing what he/she needs.

1.2.3 Objectives

The task is to further develop and improve an infrastructure for end-user service composition. The existing infrastructure includes a service creation environment, service execution environment, and a calendar application. These various components exchange service composition descriptions specified in xml. The task includes the following sub-tasks:

1. Improvement of the integration between the various components of the infrastructure

2. Generalization of the xml representation of the composite services to be in-line with the EMF terminology

3. Development of end-user service composition profile support

4. Support for location-based service compositions

5. Improvement of the graphical representation of the service creation environment and the mobile terminal client

6. Simplification of the overall end-user experience regarding creating new composite services and tailoring existing ones.

New service components will also be implemented and new service composition scenarios will be worked out. The focus will be on scenarios where calendar, location-based and telephony service components will interwork.

1.2.4 Selected Approach.

The control flow based composition approach seems more applicable in composing of telephony services. Combining this with visual programming will make the end user experience much more easier. In addition context aware service discovery should be integrated in the approach whereby the users' context is considered when composing services, thus automating the service execution. The location and time contexts will be mainly focused on. The approach should also contain the functionality to allow users compose their services on the fly, therefore eliminating the need to conform to only a set of services probably composed by the network operators.

In order to achieve this, the existing tools for end user service composition will be studied and extended to incorporate the above mentioned goals. This involves the following:

- User centric design: This will be carried out through the Scenario-based design which is a technique in which the use of a future system is concretely described at an early point in the development process through narrative descriptions. These narrative descriptions will focus on possible end users of the system and how they can use the system to compose services. The envisioned usage scenarios are then employed in a variety of ways to guide the development of the system. In this particular case the scenarios will define the performance (functional requirements) of the system as well as the usability requirements that ensure end user service composition can be implemented.
- A prototyping approach will be followed whereby the tool is developed as a prototype, whereby the prototypes are developed and tested against the requirements. At each stage of the development the requirements are reviewed and the tool improved to ensure that the tool completely conforms to what is required.
- The prototypes will be assessed through the Performance Assessment of Software Architecture (PASA) approach and the Scenario based Architecture Level UsabiliTy Analysis (SALUTA), where the service composition tool will be assessed on its ability to allow end users compose services. PASA will focus on the functional requirements while SALUTA focuses on usability of the tool.

All in all the approach will ensure that the objectives mentioned above are met and a tool that will allow for end users to compose services will be developed. This will allow users who do not have any programming or technical skills to compose services.

1.2.5 Scope

In this thesis we focus on the development of mechanisms necessary to support end-user service composition. We concentrate specially on the process of supporting the composition of existing services to satisfy specific end-user requirements. We assume that users driving the service compositions creation, by making use of a service composition tool, are heterogeneous, which means that they may have different requirements from a supporting system. Therefore the scope is on end users and this should be focused on from an early stage of development.

The proposed approach aims at providing the necessary mechanisms to ensure that the output of the Master's Thesis work meets the objectives mainly by using sound development processes and standards such as the use of scenario based design as well as evaluation techniques.

In addition the focus is on human computer interaction (HCI) techniques that will help improve the usability of the tool. HCI can play a major role in end user service composition as it simplifies the way users interact with the system.

In this thesis we do not address the following issues:

- User privacy, security and trust: this is an important issue in service composition but this is not considered here.
- Web services: although most work done on service composition is based on web services we do not look into this field when developing the tool. In this work we focus on telephony services, presented as components in a tool. Although a study will be carried on the technologies used in coming up with web services.
- User context and preference models: user context and preferences information are considered to facilitate the service composition and execution processes. However, we do not investigate neither develop models to optimize the representation and interpretation of this type of information.

1.3 Structure of the Report

Chapter 1 introduces the project by looking at the motivation and the problem to be solved. In chapter 2 the report looks at service oriented computing and supporting architectures, programming models and techniques required to implement service composition in mobile environments. Chapter 3 focuses on the user centric design, where a scenario based approach is followed. This is done by carrying out a field study and finally coming up with scenarios that are based on actors who are a description of the probable system users. Chapter 4 focuses on the service composition tool that has been developed. Chapter 5 further evaluates the tool applying its usage in the scenarios developed. Chapter 6 discusses the outcome of the project and the future developments. Finally chapter 7 concludes the Masters Thesis.

2 State of the Art

The topic of end user service composition is focused at enabling end users without technical expertise to take advantage of the benefits of service composition. It is essentially fostered by the current emerging services and SOA based technologies which have succeeded in the field of service composition. SOA enables service providers to expose their applications to third parties through reusable services. Therefore this chapter looks at the technologies that have enabled SOA's success. In addition due to the inability of SOA to handle human-machine interaction, this chapter further delves into the reasons why SOA is not suitable for end user service composition and looks at what should be incorporated in order to make SOA more user centric. Further the most successful tools that enable end user service composition are also looked at and view some of the techniques they employ in allowing for easier ways of service composition.

Since the study is also based on mobile services a look at how service oriented architecture can be modified to handle mobile services. In this case the concept of mobile services is looked into. From the concept of mobile services it is identified that context play a big role in mobile service composition. Thus finally the chapter will look at context aware service composition and the techniques that allow for effective context aware mobile service composition

2.1 SOA Realization Technologies

Service Oriented Architecture (SOA) is an architecture that provides guidelines on how services are described, discovered and used. In this section an overview of the main realization technologies of SOA is given. There are four main approaches in SOA that provide specifications and standards for interoperation among services [7]: the WS-* family, ebXML, semantic Web services, and REpresentational State Transfer (REST)-ful services.

WS-*[8]: The WS stands for web services. Web services are self-contained, modular applications that you can describe, publish, locate, and invoke over a network. Web Services are exposed using technologies like WSDL, SOAP, and UDDI. WSDL stands for Web Service Description Language, which is a W3C standardized language for describing services functionalities, inputs and outputs.

The WSDL description file is referenced in a Universal Description Discovery and Integration (UDDI) registry. Simple Object Access Protocol (SOAP) is the inter-service messaging protocol which enables services to transmit data with each other.

Electronic Business using eXtensible Markup Language (ebXML) [9] is a modular suite of specifications that enables enterprises of any size and in any geographical location to conduct business over the Internet. Using ebXML, companies now have a standard method to exchange business messages, conduct trading relationships, communicate data in common terms and define and register business processes.

Semantic Web Services, like conventional web services, are the server end of a client–server system for machine-to-machine interaction via the World Wide Web. Semantic services are a component of the semantic web because they use markup which makes data machine-readable in a detailed and sophisticated way similar to the human readable HTML. A key limitation of a "classical SOA", as mentioned above, is that the standards used for describing Web services provide very little detail about the service, beyond a simple description of the external interface they provide. With these descriptions it is impossible to provide further information about a service, such that reasonable inferences can be made with regards to the functionality of the service, or the behaviour of its interfaces [10].

Representational State Transfer (REST) [7] is another emerging service architecture which allows accessing services in the same way as we access a resource in the current web platform. It uses the same syntax and semantic as current HTTP protocol. The input parameters are then transmitted as HTTP parameters; the outputs are transmitted as an HTTP response, and the operation is defined through HTTP accessing methods (GET, POST, PUT, or DELETE).

2.2 User-Centric Software Oriented Architecture

Looking at the SOA realization technologies in the previous section it is clear that SOA represents an architecture focused fundamentally on a B2B (Business-to-Business) interaction and weak for B2C (Business-to-Consumer) interactions, since it does not offer the best approach for dealing with user-service interaction. Soriano et al propose tackling the shortcomings of SOA from three different perspectives [11]:

1. SOA's aim: Conventional SOAs merely aim at facilitating seamless machine-to-machine collaboration. Therefore, with SOA, normal users with little IT expertise have not been able to easily retrieve and use services because services mostly reside within company boundaries and are only for professional use in a corporate context. Therefore users should also be incorporated in this collaboration to allow Human-to-machine interaction. This can be done through Human Computer Interaction (HCI) techniques.

2. SOA's technology: Apart from SOA's aims, this architecture relies on a set of complex standards that are not user friendly. WSDL, UDDI, BPEL and SOAP are the most widespread standards used to set up SOAs; they are not oriented to be readable or understandable by typical end-users. Due to this complexity standards that are easily understandable by end users are needed. This will allow for the creation of self-managed services. In addition these users can be self-sufficient users who can offer and consume resources via the Web not having to rely on experts.

3. SOA's government: Finally, SOAs are subject to clearly defined regulatory frameworks since they mostly exist in the corporate context. The design, provision, maintenance, and coupling of services must be compliant with legal frameworks. These frameworks to some extent tend to lock out end users in the process of service composition. Therefore flexibility that end users require for services interaction and composition should be introduced.

2.3 Existing end-user service composition Tools

Even though SOA cannot support end user service composition without being modified there are existing tools that allow for end user service composition to some extent. These tools conceptualize and approach service composition in different ways. One difference is based on the time when the composition is created. There are essentially two alternatives, which are use-time composition and design-time composition [12].

Use-time compositions are usually one-time use compositions that users create for the particular purpose at hand, for instance when a user is browsing the Web, he or she can combine services in an ad hoc manner. Intel MashMaker and Mozilla ubiquity are examples of use-time composition environments. Intel MashMaker suggests mashups that it can apply to the current page as one browses based on the site content and structure/semantic.

Mozilla Ubiquity has a collection of easy textual commands that allow the user to look for information and use that information on the current web page as well as other web sources. Example of these textual commands is map, look, add calendar, translate and email this to, which resemble natural language.

On the other hand in design-time composition a user can create a service composition in advance of using it. Therefore a user composes a service that they can reuse in many similar situations in the future. Under design-time composition the process of service composition can be classified in the following ways:

-Programming-by-example: This technique uses a particular instance of execution in existing programs as basis for creating new programs. While the user works with the system performing a task, the system is in a recording mode that captures the actions of the user, and suggests generalizations for the actions. Vegemite and Karma are examples of mashup tools based on programming by demonstration

- Visual programming: This is a programming notation that uses a visual representation such as graphics, drawings, animation or icons thereby replacing the textual programming notation with graphical notation. Popfly and Yahoo Pipes are service composition environments that use the visual programming approach.

- Forms-based creation: Using forms, tables, assembly canvases, or other special structures to simplify service composition. Spreadsheets belong to this category. In addition iGoogle, yahoo widgets and Netvibes are other Forms-based creation tools

- Script-based creation: Making the programming easier and more natural, e.g. through scripting. This technique requires a little bit of programming knowledge which can be used when scripting to create ones desired service. Firefox extension is an example of a script-based creation environment where a user can customize their browsing experience.

2.4 Service Oriented Architecture for Mobile Services

Current researches mainly focus on service composition technologies based on wired networks. In the wake of ubiquitous computing and advances in mobile device design, devices all around a person will provide an array of services that users might want to use.

Telecom operators have joined the philosophy of service composition. British Telecom with their Ribbit platform [13] and Orange with their Orange Partner program [14] have even opened their telecom APIs such as; phoning, send SMS/MMS, presence and IM to third parties. Therefore, allowing mobile services to be available for service composition.

Mobile services pose additional requirements to the SOA when compared to other non-mobile services. In order to see how a SOA can be designed to support mobile services Do Van Thanh and Jorstad [15] state that it is important to look at the architecture of a generic mobile service. The architecture they define contains the following components:

- Mobile Service: This component can be thought of as a composite service in SOA terminology. As it consists of one or several logic components and a graphical user interface which exposes the services to the user as one of them.
- Service Logic: this is the executable part of the service. In SOA this can be equated to the service and defines what the service does.
- Service State: These define the state of the service. These are state variables and other internal data used by the service logic component. This cannot be equated to any SOA terminology.
- Service Content: these are other forms of data that are used in conjunction with a service but are not part of the Service State. In addition SOA terminology does not include such a component.
- Service Content Meta-data: This is the meta-information that provides additional value to the service content.
- Service Profile: These are profiles that contain information about how the service should behave towards specific users (Users Service Profile) and devices (Device Service Profile). This concept is not found in SOA.

Jorstad et al further propose an SOA framework for mobile services. This framework builds on and extends SOA with several conceptualizations, components and mechanisms:

1. An ontology for describing mobile services concepts
2. An ontology for describing key state variables
3. An ontology for describing interface variables
4. A mobility controller component that can handle state transfer and coordinate the overall mobile service needs to implement the service equivalence logic
5. A mobility controller stub in each composite service which can coordinate actions towards the mobility controller
6. Standardized interfaces for state transfer between mobility controller stub and mobility controller stub.
7. Exposing service profiles as autonomous, self-contained services
8. Exposing service content as autonomous, self-contained services

2.5 Context Aware Mobile service composition

In the recent past mobiles have had pre-programmed settings to suite a particular environment. For instance the Sony Ericson T-28 has profiles that suite a particular environment for instance when a person goes to a meeting he/she can select the meeting profile which has the optimal settings for a meeting scenario whereby the ring volume is set off [16].

In the context of future mobile communications the users will be able to access an abundance of services typically developed by many co-operating entities in diverse service access environments and different mobile technologies. This will place a requirement for applications to be optimally delivered and executed over a large diversity of infrastructures and configurations, as well as for dynamic adaptability of services to changing conditions and contexts. The current pre-programmed profiles will not be able to meet these changing conditions and contexts as it would not be feasible to develop separate versions for different execution contexts; applications should be to a large extent aware of the environment they run on. Like in the case of the Ericson T-28 where you place your phone on the hands free unit in the car and the In Car profile is activated, intelligent mechanisms should exist for identifying the context and the particular high-level requirements of an application and mapping them to appropriate reconfiguration operations on the underlying hardware and software infrastructure.

One approach is to encode contextual information in the user profile, which consists of user preferences, terminal, ambient, network, and service profiles which describes the content elements and objects composing the service [17].

Although information about the current context may be available to mobile applications, how to use this context information effectively during service composition is a challenging problem. Schilit categorizes context aware applications in light to this problem and identifies four approaches on how to make use of the context [18]:

1. Proximate selection, a user interface technique where the objects located nearby can be selected. In this case the user uses the interface to specify what they want. For instance when driving the user can select to view the traffic information or not.
2. Automatic contextual configuration whereby adding new components, removing existing components or altering the connection of components occurs automatically due to contextual changes. This allows for the system to react to current context for instance if a person changes location they get presented with a list of new resources nearby. Even though this is desirable, contexts that change too rapidly may be impractical as it is difficult to adapt to every change.
3. Contextual information and commands which can produce different results according to the context in which they are issued. That is different commands are issued when the contextual information changes. For instance when in an office the open files command opens files related to work, and when at home the command opens entertainment files.
4. Context triggered actions, where simple IF-THEN rules used to specify how context aware systems should adapt. One can apply these rules to the context information and decide on an action to take.

3 User-Centric Design

In order to carry out a comprehensive user centric design several steps have to be taken. In this chapter we look at the steps that are followed in user centric design. The chapter begins by carrying out a field and market research study that is conducted to learn who the users are, what their goals and what their core tasks are in regards to mobile technologies. By gathering information about the field personas can be created. These personas are basically virtual mobile users who define the customer segments within the field. Also a detailed view of how, why and what these mobile users do is created. Finally, scenario narratives are created that look at the possible uses of the infrastructure that is to be created. Within this requirements both functional and non-functional requirements are identified that can be used in the design of the infrastructure. These scenarios will also be later used in assessing the success of the infrastructure.

3.1 Field Research

Focusing on end-user service composition for telephony services a field research is carried out. The field research is based on mobile telephony, how people make use of them and when mobile usage can be inappropriate.

According to Wikipedia [19] the mobile phone has become one of the most used communication tool in the recent past. Different mobile phone manufacturers exist who have differentiated their products by having different features and functionalities. However, there exist a number of features that are common in all these devices. These features may be any one of the following; GPS navigation, music (MP3) and video (MP4) playback as well as the ability to stream video, RDS radio receiver, alarms, memos, personal digital assistant functions, video calling, built-in cameras (1.0+ MegaPixels) and camcorders, ringtones, games, PTT, memory card reader (SD), USB (2.0), dual line support, infrared, Bluetooth (2.0) and WiFi connectivity, instant messaging and the Internet.

Basically mobile phones can be classified into two: The Low-end mobile phones, also known as feature phones that offer basic telephony services as well as functions such as playing music and taking photos and the Smartphones which have more advanced computing ability as they have high processing power as well as run native software applications.

3.1.1 How people use their cell phones

According to the Global mobile statistics 2011 by mobithinking [20] 77% of the world population is using mobile phones, with a high growth of smartphone use. Even with this growth feature phones still outnumber smartphones. Apart from the traditional use of making calls the following are the other uses of mobile phones:

- Messaging: The most popular form of messaging is through the use of SMS. In the statistics it is estimated in 2011 8 trillion messages will be sent. With more recent phones other forms of messaging such as mobile email, IM and MMS are also becoming popular.

- Mobile Web-3G coverage: mobile has overtaken the PC as the most popular way to access the internet, and in addition these users do not use a computer to access the web. This is because a bigger percentage of mobile phones are able to access the mobile web, also because of the high-speed mobile networks, that is 3G or better.

- Mobile marketing, advertising: through the use of SMS mobile marketing is growing rapidly all over the world. With the wake of mobile web, marketing is finding its way into mobility through mobile web ads, mobile email, IM and MMS rapidly.

- Mobile apps: many mobile applications have been developed in the past several years and demand for mobile applications is expected to rise in the coming years. The most used mobile apps are games, news, maps, social networking and music. The use of mobile apps is expected to rise as the price of the apps reduces.

- Mobile payment, NFC, m-commerce, m-ticketing and m-coupons: Payments through the use of mobiles are also becoming quite popular. Purchasing digital goods is the largest segment ahead of physical goods. Near-field communications (NFC), m-coupons and money transfer are also emerging to be alternative modes of payment.

- Mobile financial services (MFS) and m-banking: The access of financial services by mobile is also rapidly rising. The MFS is mainly dominated by the developing countries. For instance in Kenya M-Pesa [21] allows for the transfer of money between mobile users.

- Entertainment and social networking: mobile phones are also being used as entertainment tools whereby one can watch TV, listen to music, etc. In addition mobile phone users are using mobile phones to access to social networks.

Apart from its positive uses mobile communication has its negative usages. The main disadvantage of mobile phones is its inappropriate use that causes disruptions. Excessive cell phone usage can lead to addiction especially in teens, auto accidents; also some researchers argue that cell phones can cause health problems. Cell phone usage is also expensive. There have also been criminal activities connected to mobile use in recent times, such as cyber bullying.

3.1.2 Who uses mobile phones

Mobile telephony is ubiquitous with regard to not only how many people use it but also where they use it. The fact that nowadays anybody can afford a mobile phone allows for virtually anytime, anywhere connectivity. The international telecommunication union [22] states that access to mobile networks is now available to 90% of the world population and 80% of the population living in rural areas. Therefore from this information we can see that most people can afford to have a mobile phone. Even though telephone costs have gone down, it is apparent that high income earners are able to purchase mobile phones that have better features than low income earners.

According to the data given by Jonathan Carson, CEO of Telecom for Nielsen [23], women use mobile phones more than men in America. On average, women use 22 % more cell phone minutes than men, and they even send 154 more text messages per month than men. He adds that Teens text more than any other group, sending a stunning average of 2,779 texts per month. Text usage drops off steadily among older age groups, with senior citizens receiving an average of just 30 messages per month.

Sending messages has become so popular with teens and children that their usage has even pushed increasing numbers of parents to adapt to this way of communication with their kids. In addition Jonathan states that People start carrying mobile phones at younger ages. He adds that more than half of children in the range of 12 to 14 years are now carrying mobile phones,

The online and physical-world survey carried out by DingoAccess [24] contained three questions relating to the use of mobile phones by old people. Most of the survey participants indicated they owned and used a mobile phone. This survey shows that old people consider the use of mobile phones quite important. Their usage is mainly making calls although a few use other features. The rise can probably be attributable to the fact that mobile manufacturers such as Doro are creating easy to use big button phones, which are fit for use by the old people [25].

Due to the support of marketing by mobile phones it is highly likely that business people will make much more use mobile phones. In addition smartphones are offering much more features for lower prices thus giving a higher value for money. Therefore business men are able to do much more with their phones.

From this we can depict that even though different people in the society use mobile phones for different uses and in different ways everyone in the society seems to need a mobile phone.

3.2 Personas

In light of the field study carried out a few personas are presented to try to come up with a representation of mobile phone users, cutting across all the divides. The personas presented look at the different user ages ranging from the old to the young, considering different occupations and people with different goals. The personas also look at people with different levels of technological skills. The first persona is Jane who is a representation of a parent taking care of different family members. Also in connection to Jane is Esther who is a representation of the old age group. Drake is a representation of an entrepreneur who is running a business. Dan on the other hand is an employee who is in a managerial position. Finally Ian is described as a student at the university.

Jane Rodgers

Bio Overview

Age: 32 years

Gender: Female

Residence: Trondheim, Norway

Occupation: Sales Executive

Goals

-Taking care of her family

-Moving up the corporate ladder at work

Mobile Phone Usage

-Knows how to use normal phone features

-Uses advanced phone features such as GPS, Bluetooth headset, map and internet.

"In many instances, you as the parent feel like your hands are tied when it comes to allowing your child unregulated access to the world"

Personal Information

Jane is married to scot. Together they have two children. These are two girls Sophie and Stacy. In addition she takes care of her mother who is elderly and sickly. She makes sure the mother goes to all her appointments with the doctor.

She recently also got a promotion at work to become a sales executive, which means she is always busy with work recently. The husband too is really busy and they do try to share the tasks that they should carry out taking care of the girls and Jane's mother.

Technology Use

Jane is pretty tech savvy. She likes to keep latest technology. But she has no experience in program development and programming languages.

Currently Owns:

-Smartphone

-Laptop

-Desktop Computer at the office

Drake Michaels

Bio Overview

Age: 30 years

Gender: Male

Residence: Oslo, Norway

Occupation: Businessman

Goals

-To meet his responsibilities as a business owner

-Making profits for his business

-Penetrate more markets

Cell Phone Usage

-Knows how to use normal phone features

-Uses advanced phone features such as GPS, internet, map and calendar.

"ensuring customer satisfaction by giving the best customer experience while cutting down on costs"

Personal Information

Drake is a young entrepreneur who deals with supplies all over Scandinavia. The business is run online on his web page. In cases where there's anything important, or the relationship seems strained with a client, or if he needs to explain something complicated, or introducing himself for the first time he travels to the client's site. He often finds difficulty in managing his travel arrangements and would be interested in a tool that can help him manage his meetings with his clients as well as minimize some of the costs he incurs on the road.

Technology Use

Drake tries as much as possible to keep abreast the fast changing technology. He has no programming knowledge.

Currently Owns:

-Smartphone

-Laptop

-Desktop Computer

Ian Phillips

Bio Overview

Age: 29 years

Gender: Male

Residence: Trondheim, Norway

Occupation: Student

Goals

-Get good grades

-Manage his time wisely

Cell Usage

-Knows how to use normal features

-Knows how to install applications

-Uses advanced phone features such as GPS, Bluetooth headset and calendar.

"The secret to good grades is managing your time well"

Personal Information

Ian is a master's student at the Norwegian University of Science and Technology doing Globalization. He has a bachelor's degree in information technology. He is a foreign student and finding it quite hard to fit into the new environment, this is due to the fact that after his bachelors he worked for six years and is having trouble adjusting to life as a student. The amount of material that he has to read, the assignments, not to mention the projects are really giving him a hard time. Ian has a problem managing his time and would like a tool help him do that.

Technology Use

Ian has a lot of knowledge in Information technology. He is a keen follower of the latest technologies. He gets to know about different technologies from journals and technological talk shows. Ian has experience in program development and programming languages from his bachelor degree studies.

Currently Owns:

-Smartphone

-Laptop

Dan Carlos

Bio Overview

Age: 32 years

Gender: Male

Residence: Oslo, Norway

Occupation: Delivery planner

Goals

-Making his work easier

-Moving up the corporate ladder at work

Cell Usage

-Knows how to use normal features

-Knows how to install applications

-Uses advanced phone features such as GPS, Bluetooth headset, checks email.

"We strive to be the best home based grocery delivery service in the city. When you need fresh groceries, you can trust us to deliver."

Personal Information

Dan has been working as a warehouse manager with one of the biggest retail stores in Norway for a few years now. Recently he was promoted as head delivery planner for the new department opened up to venture into home based delivery of groceries. His main aim is to ensure that deliveries get to their destinations on time by planning routes for different delivery persons.

Technology Use

Dan is quite interested in technology but believes in using technology that can only help him in his day to day life. Though he has no knowledge of program development he researches on technologies that can bring cost benefits to the organization and technologies making his and other employees work easier.

Currently Owns:

-Smartphone

-Desktop Computer

Esther Wells

Bio Overview

Age: 75 years

Gender: Female

Residence: Trondheim, Norway

Occupation: Non (Elderly Person)

Goals

-Taking care of herself

-Challenging herself to fight the problems brought about by old age

Cell Usage

-To some extent knows how to use normal features of the phone.

-Has no knowledge on use of the advanced phone features

"If she is provided with the right assistance she can keep track of her appointments and feel safe on her own, helping her feel confident and independent"

Personal Information

Esther is 75 years old, and starting to get forgetful. She is finding it harder to manage on her own as she gets older and starts to forget things. She has trouble remembering her doctor's appointments and keeping track of the bus schedule.

Her daughter Jane is concerned about her condition, but she is very busy with her work. She has to assist her, but believes with a little help the mother is capable of managing the appointments on her own. If she is provided with the right assistance she can keep track of her appointments and feel safe on her own, helping her feel confident and independent, which will in turn help her stay mentally fit longer.

Technology Use

Esther is least bit interested in technology. Recently her daughter bought her a cell phone so that she can keep in touch with her. It was difficult for her to use the phone at first but after a few lessons by the granddaughter she was able to use it. She has no technical expertise of any kind.

Currently Owns:

-Smartphone

3.3 Scenarios

In this section we take a look at several different scenarios which put the personas stated in the section above in real life situations that may require them to compose end user services. In each of the scenarios an activity design and interaction design are defined. The activity design shows the activities that the persona will carry out in the composition process and the interaction design looks into more detail on how the persona is to interact with the system while composing services. The first two scenarios, parental control and doctor's appointment, focus on Jane whereby Jane composes a parental control service for her daughter's phone and the second one she composes a service for her mother to help her remember her doctor's appointment. The third scenario is a home based delivery scenario whereby Dan composes a service to help in the planning and monitoring of deliveries. The fourth scenario is the busy student scenario whereby Ian composes a service to help in managing his time as a student. The fifth scenario is the travelling businessman, whereby Drake composes a service to help in scheduling for meetings. Finally the delivery planner scenario looks at how Dan composes a service to plan for deliveries.

3.3.1 Parental Control Scenario

As a parent, you provide your children with cell phones to keep in touch. The question of how old a child should be before they can be allowed the use of a mobile phone is a debatable one, mainly because of the consequences that might come with it due to misuse. Often, children don't see the problems that come about due to misuse of the phone, such as using the phone at inappropriate times or conversing with the wrong people. In many instances, parents feel like their hands are tied when it comes to allowing children unregulated access to the world, especially with mobile phones. In this scenario we look at how parents can allow their children the use of mobile phones in a controlled manner by composing a parental control service which controls the usage of the phones. In addition the scenario also introduces the concept of tracking which enables parents to monitor the movements of their children.

3.3.1.1 Problem Description

It's the beginning of a new school year and Jane's fifth grade daughter Sophie has been begging to get her first ever phone. In her fourth grade class she was the only one in her class without a mobile phone. Jane has decided she is ready for that first phone, but she is not willing to allow her a phone without control.

Her concern is that Sophie will spend a lot of time talking on phones or sending text messages that she is not aware of what is happening around her. With regards to this, Jane is mostly concerned about the following:

- Despite the fact that the mobile phone she will buy might be cheap, there is still the question of expenses brought about by phone use. Jane is afraid that she may be unable to cope with the huge amounts of bills she will incur due to the abnormal usage of the phone by her daughter.

- In addition the mobile phone can be an interruption to Sophie's study. In addition most schools do not allow the use of mobile phones while in school. This is because of the disruptions that come about with it. For instance, if Sophie is texting or chatting online while in class, will undoubtedly prevent her from being attentive in class. Also a ringing phone disrupts the learning process not only for Sophie but her classmates as well.

- After reading a few articles Jane is also aware of the fact that owning mobile phones also brings about other dangers such as cyber bullying, where children are harassed on phone.

- A lot of content can also be accessed by children on the phone. The ability to connect to the internet can lead to the child accessing inappropriate material such as pornography and gambling.

In addition Jane and her husband have been quite busy at work lately. She would want the daughter to be going home by herself. It's only natural that Jane worries and wants to know where her child is at all times when she's out and about. She has heard that there are tracking features on current smartphones that can allow her to track her daughter's movement and would like to use this feature in order to limit where the daughter gets to go.

3.3.1.2 Goals and Objectives

In light of these concerns Jane feels parental control is of at most importance. Some mobile providers allow for parental control but it's not straight forward for Jane to set up the parental control features. An end-user service composition tool for telephony services can make this process of setting parental control easier. Jane wants to meet the following goals and objectives with regards to parental control:

1. Tracking Sophie’s Movement

Jane wants to know where Sophie is and get alerts when Sophie is at school, at a friend’s house or any other place. Jane does not want to rely on her daughter to let her know where she is, because she might not be completely honest or she might not be able to.

2. Usage control

Jane also wants to be able to control when the features of the daughter’s cell phone can be used, and what the child is allowed to access. For instance, she can set the time when the child can receive phone calls to ensure that the Sophie isn't staying up all night on the phone, or using it in class. She can also block the phone from contacting or being contacted by unknown numbers, therefore preventing things like cyber bullying.

3. Content filters

Jane intends to set filters for what content her daughter can view on her phone. These include what she can view on the web as well as in text messages, multimedia messages and e-mail.

Jane also has usability requirements, whereby she would like a system that is simple to use. In addition the system should be able to meet the set objectives. Jane would also like a system that is easy to learn. Finally Jane would like a system that does not require a lot of user intervention. The system processes should be automated. This will allow for Jane to efficiently compose a parental control service.

3.3.1.3 Activity scenario

In order to create a service for her daughter, Jane connects to the service creation environment where she creates a service, before she can give her daughter the mobile phone. This cell phone will be running the service and will keep track of Sophie’s location and control the usage of the phone.

The service keeps track of Sophie's position, and has various locations updated specifying where she should be at what time. Jane will enter all this locations in advance and set for messages to be sent to her when Sophie either enters one of these locations or leaves these locations.

Sophie usually goes to school nearby and when she leaves school she goes home or goes to her best friends place. Therefore Jane sets the home, school and friends location. Sophie's position is tracked using the phone. In the case she moves outside the radius of these locations a message is sent to Jane's phone. In addition when Sophie arrives at the specified locations the mother is also notified. Jane also chooses a larger radius, the safe location, which Sophie should not at any one time be outside of. In the case Sophie is outside this location, Jane will be notified of Sophie's position continually, with the coordinates and location after a set duration, say every five minutes. Jane can also log in to the map and view Sophie's position. In this case Jane can call Sophie to identify why she is outside the safe location radius.

In addition the service will control how Sophie uses her phone. Jane will set specific times when Sophie can use the phone. In addition Jane will specify the locations when the phone can and cannot be used. Jane does not want Sophie using her phone in school, so whenever Sophie is in school she will not be able to receive calls apart from specified numbers. She will also not able to make calls in this location. In addition Jane does not want Sophie using her phone late at night either calling or sending messages. Therefore Jane sets that all calls be disconnected after nine o'clock in the night, apart from calls from her number or Sophie's father number. She also wants to disconnect her internet connection after this time as she might be chatting or surfing on her phone late into the night.

Jane also sets a service to filter out content that is inappropriate for her daughter. She does this by specifying the internet sites that her daughter should not be able to view. In addition she sets the words that should also be censored from her daughter. Jane should periodically update this list with new inappropriate content.

Figure 3-1 shows the core activities that Jane requires in order to confidently allow the daughter to use the phone, knowing that she can control how the daughter makes use of the phone. Whereby, these activities should be running automatically in the background without any human intervention, in order to allow for parental control.

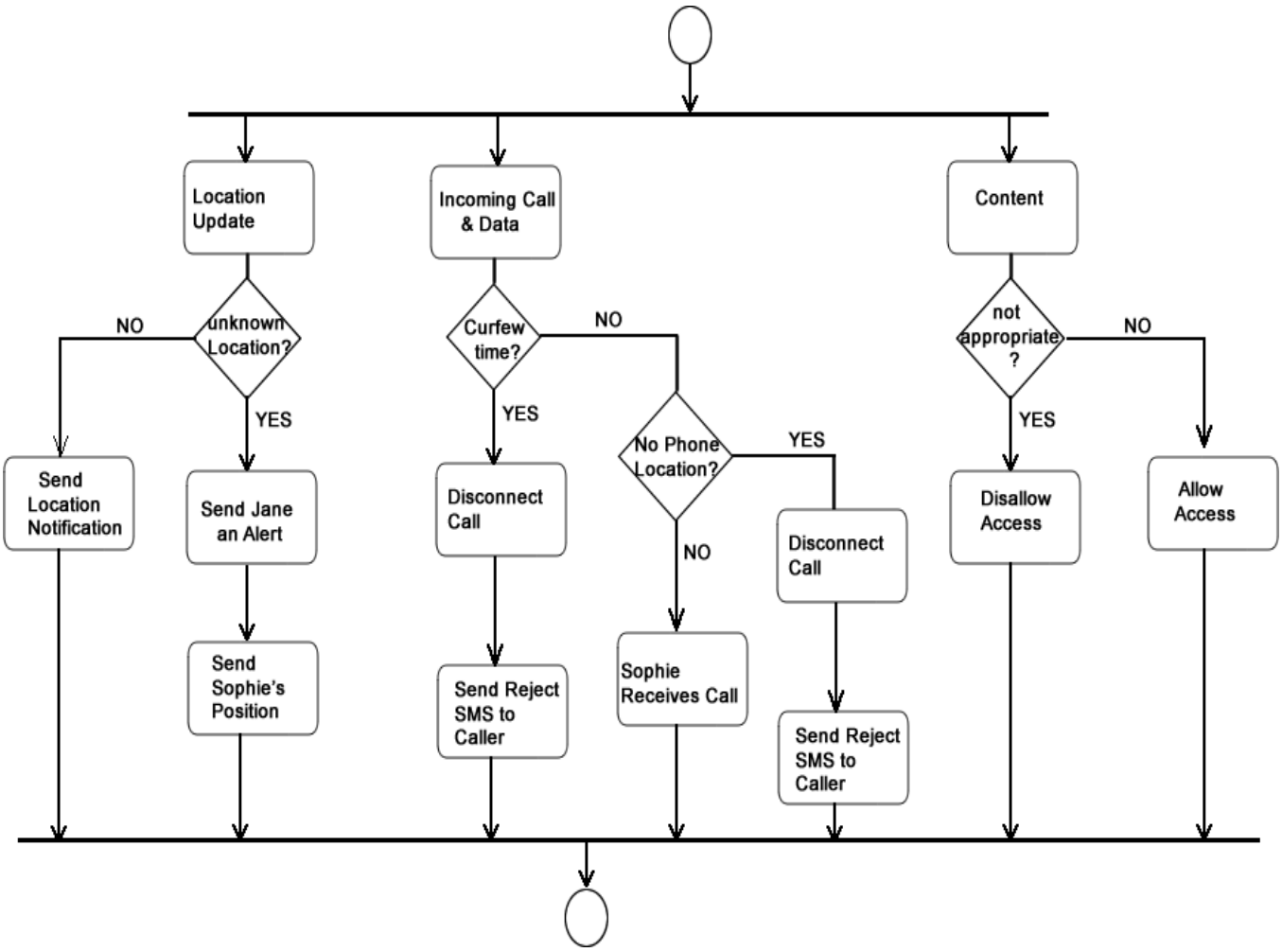

Figure 3-1 Parental Guide Activity Diagram

3.3.1.4 Composition scenario

The need for the service arises because Jane wants to get her daughter Sophie a mobile phone, but she is not willing to give her daughter the phone unless she can control its usage. Despite her scepticism Jane has finally accepted to buy her daughter a phone but with parental control service running on her daughters phone to control its usage. Jane wants to compose a parental control service for her daughter's phone.

In order to be able to track Sophie's movement Jane logs in to her service creation environment and opens the map facility where she chooses intended locations for her daughter. She searches the address of the location and saves it on the database with a unique name such as school, home and friend's place.

In addition she creates one location that she calls a safe location which is a larger radius that encompasses all locations and is the area that Sophie should be in at all times. Within these locations Jane sets alerts. These alerts will be in form of SMS messages sent to her phone. She also specifies that these alerts will be produced when Sophie enters or leaves these locations. Figure 3-2 shows how Jane interacts with the system in order to allow for location tracking.

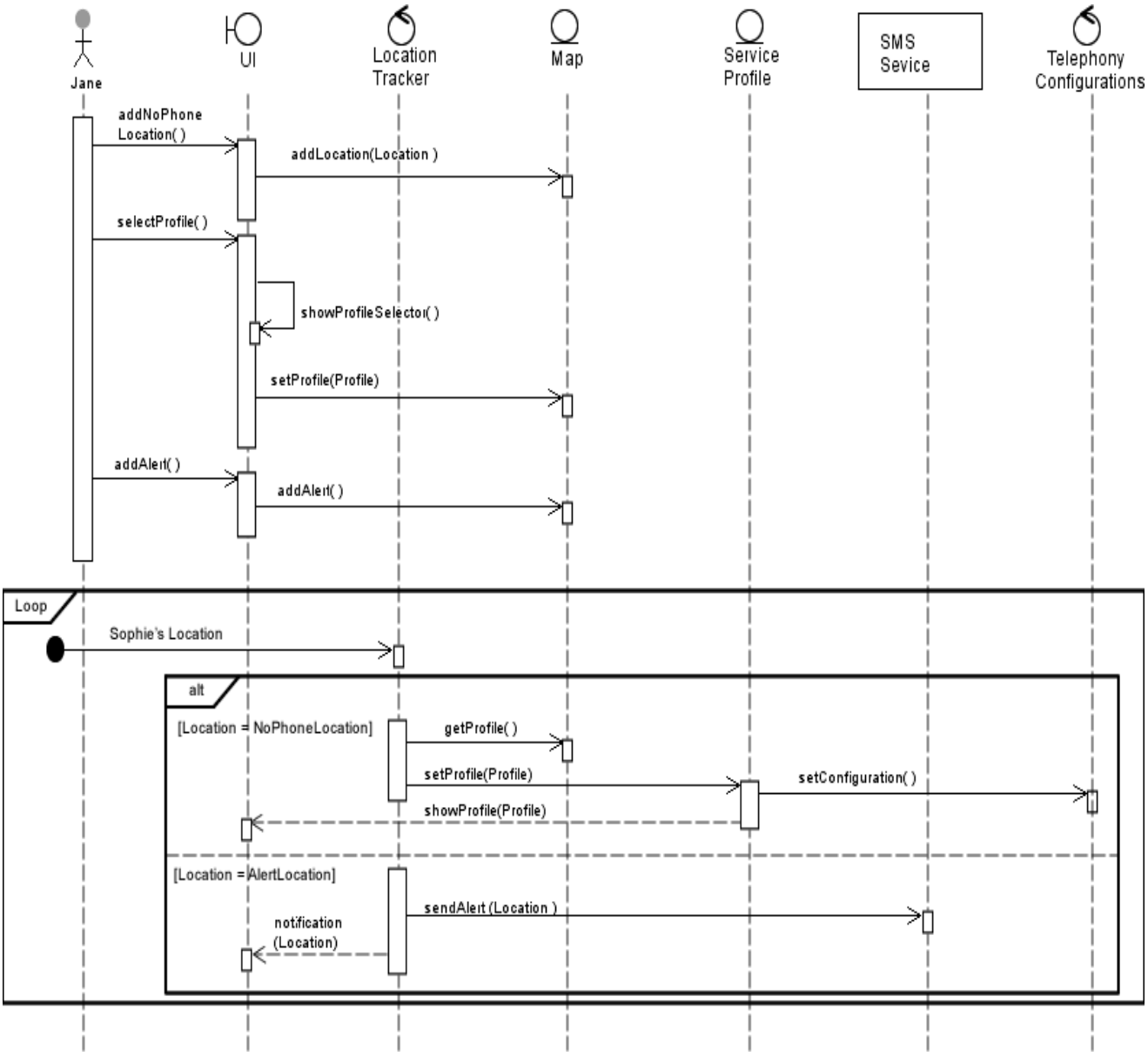

Figure 3-2 Parental Control Scenario Location Based Interactions

Figure 3-2 further shows how the usage control can be implemented within locations. For the usage control Jane will first enter the map facility again. If the locations that she wants to control the usage of the phone are not present she will add new locations. In this case she will for instance add the church location. She will then specify that within the church and school location calls will be disconnected apart from calls coming from her number or Sophie's father.

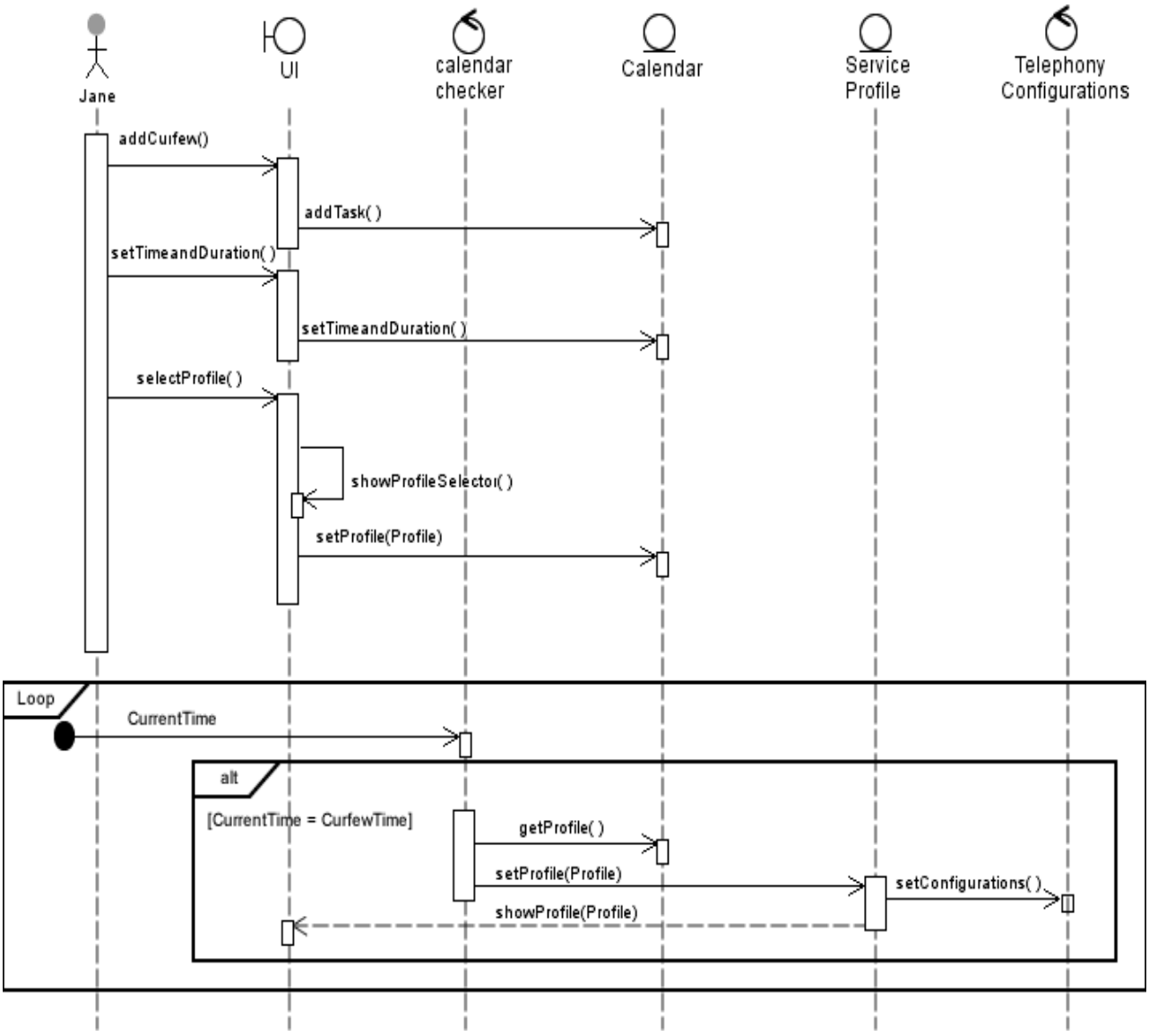

Figure 3-3 Parental Control Scenario Calendar Based Interactions

On completing with the locations she accesses the calendar facility. Figure 3-3 shows how Jane interacts with the calendar in order to specify time when the mobile phone can be used. Here she logs the times when the daughter should not be using the phone. She specifies that only certain numbers can reach the phone at this time. These numbers are Jane's and the father's number. In addition she also specifies that the internet connection is disconnected.

Finally Jane connects to the parental control feature which allows for censoring of certain words in messages and call conversation. In addition she also specifies content that cannot be viewed on the phone such as internet sites as well as multimedia content such as videos and music. Now Jane has reached her composition goals, and the parental control service created can aid Jane in ensuring that Sophie uses the mobile phone in a proper manner, without getting into any harm.

3.3.2 Doctor's Appointment Scenario

Doctor's appointment is picked from a scenario that is specified as part of the UbiCompForAll [26] project. In this case it is considered in order to identify how people with special needs can benefit from end user service composition.

At an old age many people have failing bodies that slow down physically and have limited regenerative capabilities more prone to disease, and sickness forcing routine visits to the doctor. There is often a common physical decline, and people become less active. Old age may also bring a lack of ability to concentrate, forgetfulness, inability to speak, to hear, to see etc, which leads to the elderly feeling helpless. This old people also may not have people to take care of them as their children are not around and this might bring about despair. In order to get rid of this despair the elderly should be challenged more often to try and take charge for their own well-being.

The scenario primarily focuses on Jane who creates a service to help her ageing mother get to her doctor's appointments. It keeps track of the appointments, reminding her when it's time to go, and it lets her keep track of the mothers movement to the doctors and alerts her of the progress.

3.3.2.1 Problem Description

Mostly elderly people have no one to take care of them. In this case Jane's mother is elderly and has no one to guide her in her day to day activities. This is mainly due to the fact that Jane has her own family that she needs to take care of and in addition Jane is very busy at work. Further Esther likes to do things for herself as she likes to think that she is in charge of things. Another problem arises as not able to concentrate and at the same time very forgetful.

Esther has been sick lately and in and out of hospital for the last few months and she has appointments with a doctor who follows up on her health condition. She has tremendously improved and lately has regained her strength. She still has to go for the appointments and since Jane is quite busy Esther has opted to go to the doctor's on her own. In addition Esther has gotten lost several times while going to the doctor.

Therefore a problem presents itself whereby Esther forgets most of her appointments and has problems going to the doctor. Since Jane is quite unavailable a service is required to make sure the mother gets to her appointments and back.

3.3.2.2 Goals and Objectives

In the light of this problem the following are the goals and objectives that Jane wants to achieve when composing a service for her mother:

1. Reminders

Jane would like to set reminders for all her mother's appointments with the doctor in good time so her mother can prepare and also take the bus in good time. In addition Jane would like to get similar reminders to call her mother in order to remind her of the appointment and also checking on her condition to see if she is fit to make the trip on her own. If not she will have enough time to arrange for her to get to the appointment on time.

2. Tracking her mother's movement

In addition Jane would like to track Esther's movement to ensure that she does not get lost. Whereby if not at a particular place at any one time she can confirm why the mother is not on track.

Jane also has usability requirements slightly similar to the ones under the parental control scenario. She would like a system that is simple to use thus making the service composition process easy. Jane would like a system that is easy to learn. Finally Jane would like a system that does not require a lot of user intervention therefore will relieve the mother the need to interact at great levels with the system thus making it easy for her to use.

3.3.2.3 Activity scenario

Jane connects to the service creation environment where she creates a service for Esther from her own computer and enters the time and date of her next doctor's appointment. Esther's cell phone is running the service; which alerts her of the appointment with an alarm or a message at specific times. In this case one hour before she must leave for her to get ample time to prepare herself, and when it is time for her to leave the house. The service keeps track of Esther's position, and has a route with schedule specifying where she should be at what time relative to the appointment times. Her position is tracked using her phone.

Messages are sent to Jane's phone to alert her of an upcoming appointment, and when her mother should leave the house, so she can be prepared to contact her if a problem occurs. And she is alerted if Esther deviates from the schedule set.

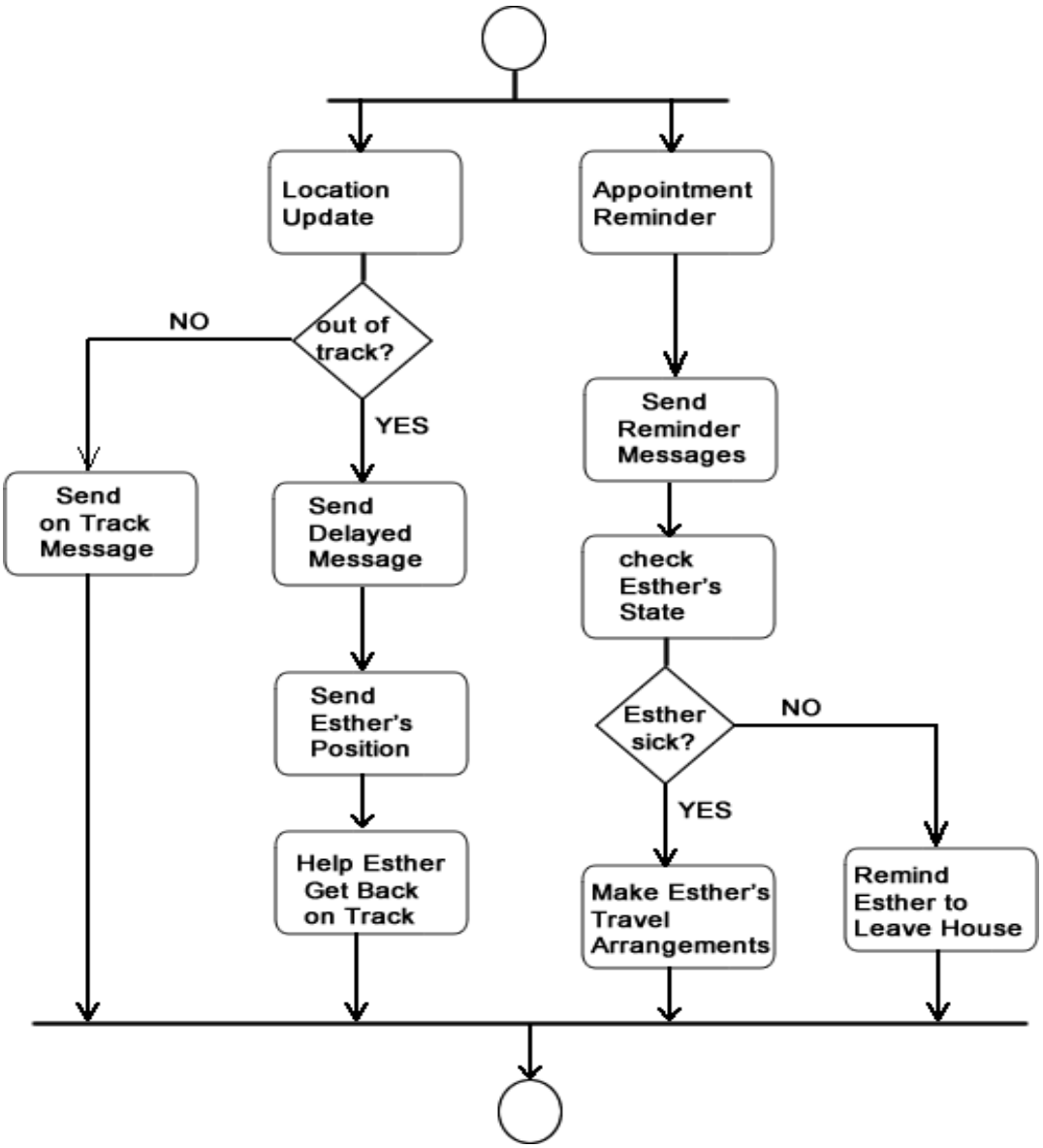

Figure 3-4 Doctor's Appointment Activity Diagram

So Esther finds her bus stop, waits for the bus and rides it to the city centre. It keeps track of her position, all the while alerting Jane on the progress. While at the bus stop Esther gets confused and gets on the wrong bus. With a change in her position that is not within the scheduled route, the system alerts Jane.

She calls her phone to ask her why she is not on track, and enquires on the reason, and on enquiries finds out she is on the wrong bus where she asks her to alight and Jane finds her the right bus she should take from her current position in order to reach the doctor on time. If need be she calls the doctor informing him of the probable delay. Continuing, she reaches her doctor. The system will assist her in a similar way when returning home, without the time of an appointment to worry about. Figure 3-4 shows the process mentioned above that ensures Jane's mother gets to her appointments.

3.3.2.4 Composition scenario

The need for the service arises because Esther has missed a few of her last appointments with her doctor. She finds it difficult to remember the details about when to go for her appointment. At other times she has gotten lost on her way to the appointments. Her daughter Jane wants to compose a service to help her while letting her manage on her own as much as possible. She wants to keep track of her mother's progress when going to the doctor, and she wants to be able to help her even when she's not close.

Jane composes a service on behalf of the mother and herself, her mother is the main user of the service but she also has roles in its use. Jane composes the service on her home computer where she has installed the composition software and has access to components available. She wants the service she creates to provide all the support Esther needs with minimal user interaction, so that she doesn't need to worry about anything unless she gets an alert. She wants it to be accessible from different terminals. She wants to be able to build on it in the future, adapting it to other appointments and destinations. As she is a first time user she will start simply by creating a usable service with some basic functionality, and add to it later. The composition system lets her create a schedule of appointments in the calendar. Jane further sets up different tasks to run relative to the appointment times. These tasks are simply the sending of SMS messages whereby an SMS is sent that informs the mother that the appointment is in an hour's time, so she can prepare herself and another SMS informing her when to leave the house. Figure 3-5 shows this interaction between Jane and the calendar.

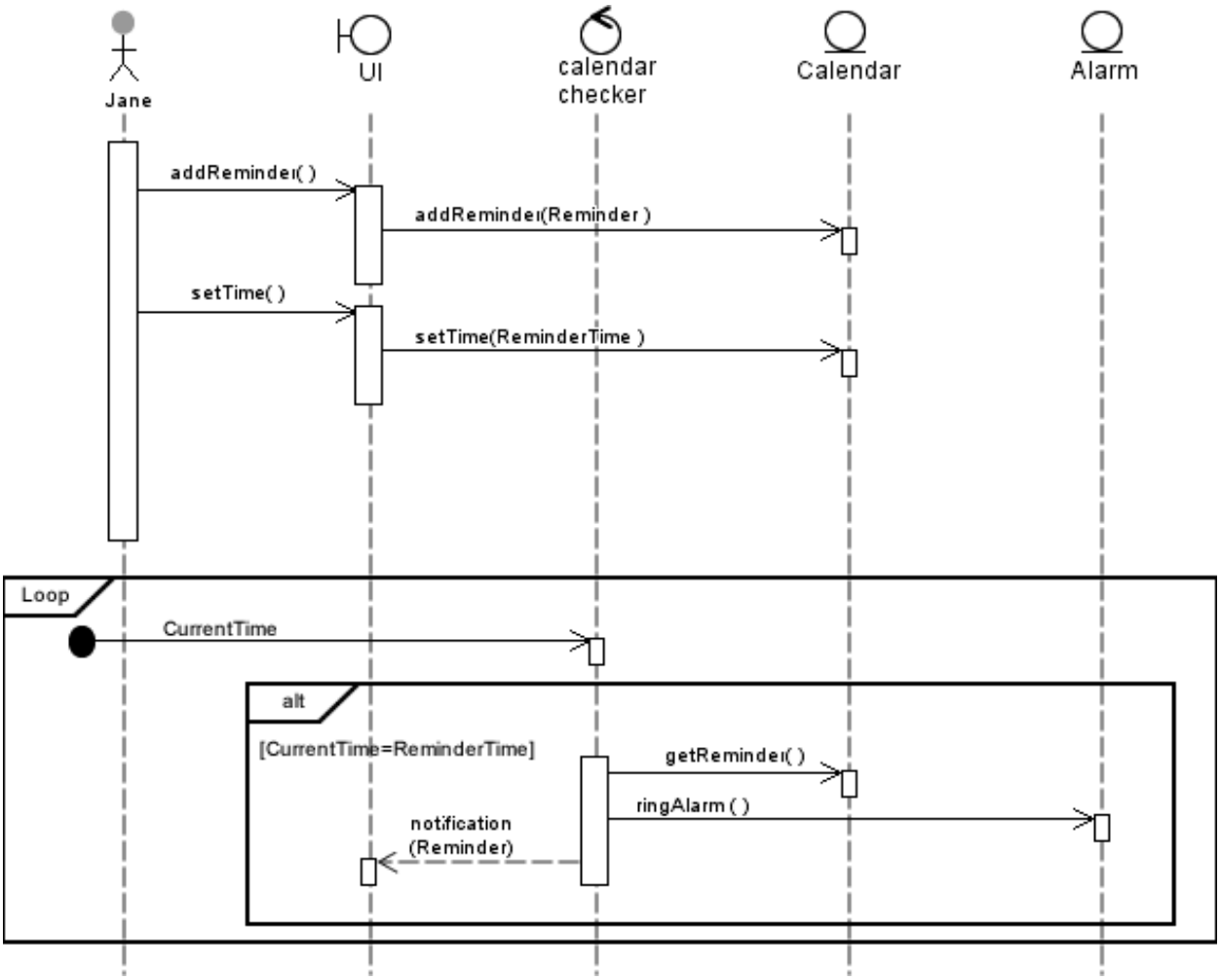

Figure 3-5 Doctor's Appointment Calendar Interaction

This service also allows for tracking of Esther's position and a schedule is created to be checking periodically. Here she adds a condition to the composition, having it send her a message only if the mother is not at the doctor's at a certain time and another if she is outside a certain radius on her way towards the doctor's.

For the final version of the service, Jane adds full tracking of Esther's position. She sets up a route, consisting of positions and time offsets for when they should be reached. The list of the positions is fed to the locations component to track movement. Esther's phone sends out an event each time she reaches a position in the list. Given a list of events, each with a time and allowable delay, it sends out an alert to Jane if an event is not registered on time. The route is used as a list of events, so Jane is alerted if the route is not followed. This interaction with the map is shown in Figure 3-6.

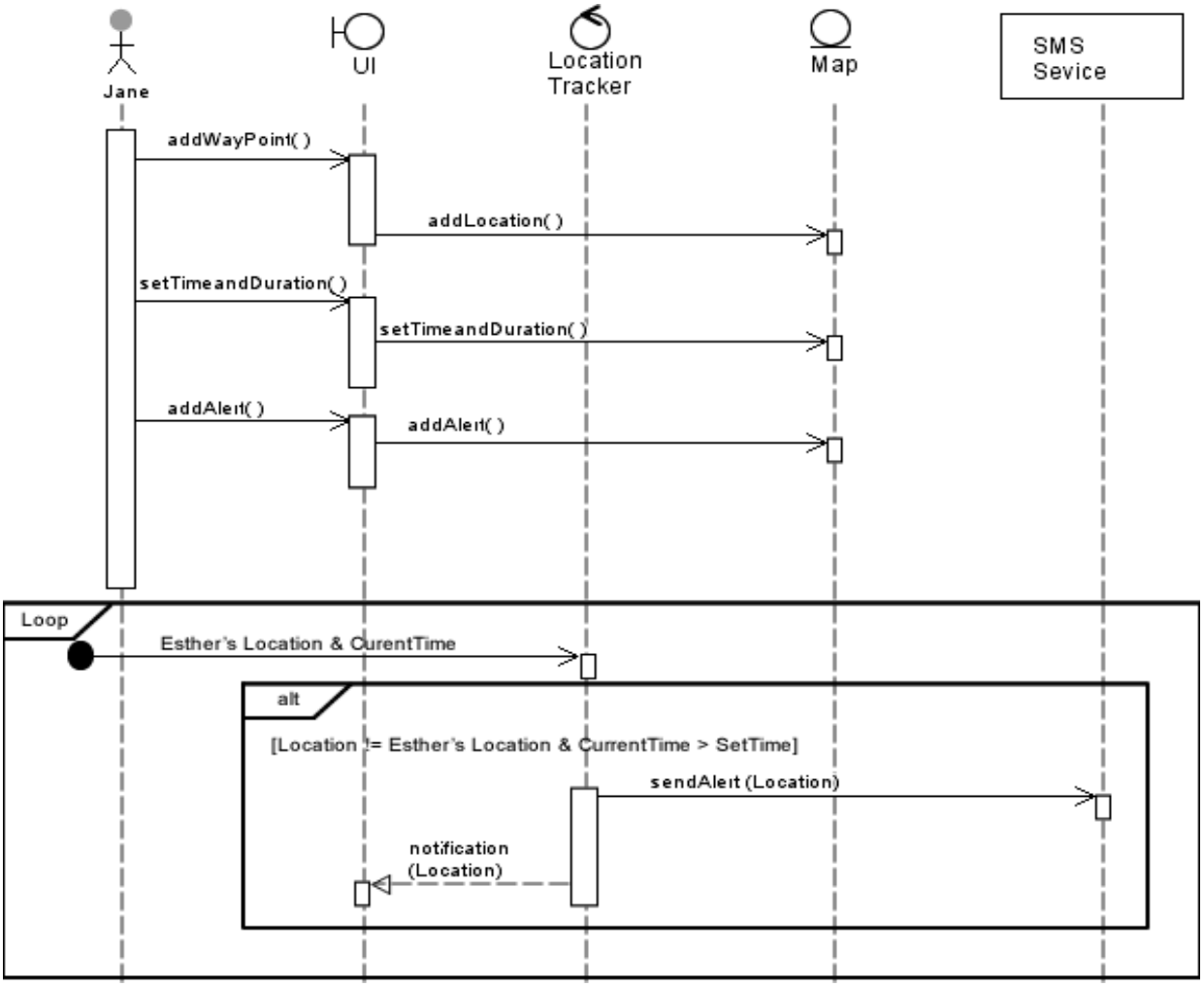

Figure 3-6 Doctor's Appointment Map Interaction

If this is successful she will then incorporate the bus routes into the service so that the service can inform her mother when she needs to catch a bus. This will also be helpful on her way back home. Now Jane has reached her composition goals, and the service can aid Esther in attending her doctor's appointments.

3.3.3 Home Delivery Scenario

CooP is making sure it maintains its retail dominance by exploring opportunities online. They have decided to venture into an online service related to its grocery business. A grocery delivery service can be a convenient option for anyone, including the elderly and other people with limited mobility or lack of transportation. Busy families can also take advantage of online grocery shopping services. In the initial stage the company will start in Oslo and later to other parts of the country.

In order for them to succeed in this new venture they need to plan well for their deliveries, Dan needs to know where the delivery men are at all times. Dan should contact a deliveryman who is closest to the area where a delivery is required at any one particular time. Therefore when a delivery man leaves the warehouse for their daily rounds they should know the regions where they are meant to be operating. In the case an order is made, Dan can send the closest person to handle the delivery at the same time ensuring that the deliveries are made on time and the deliveries are correct.

3.3.3.1 Problem Description

A research carried out for the department of business innovation and skills in the UK by Mick Jackson et al [27], shows that home delivery of grocery is a market with significant growth potential. It is closely linked with e-commerce and the internet and also allows for ordering methods that make use of telephone and fax.

When orders are received the delivery planner contacts a deliver person who gets the products in their stores, packs them and delivers them to the delivery address, within the time required. CooP having set up their home delivery operations in this style are facing similar problems as outlined in the paper by Jackson et al [27]. There is a problem managing deliveries in the different parts of the city as most of the time the deliveries are handled by persons who are too far from the delivery address and also there is a problem of monitoring these deliveries. In addition other minor problems are being experienced such as those of not finding the delivery houses, parking, accidents and traffic congestions. Their current operations are facing the following major problems which affect the success of their business venture:

- Customer not at home: This is whether there is someone at the customer's home to receive the delivery. Even when the customer has agreed to the day and time to make the delivery there have been many incidents where the delivery personnel do not find the customer at home. This leads to wastage of time and resources, as it brings additional costs when planning for redelivering the groceries. This problem also affects the products due their perishable nature.

- Faulty or damaged goods delivered to home: This is mainly caused by delay of delivery. This is because the nature of the products being transported is perishable. This brings about extra costs of replacement and redelivery of the goods.

- Failure to meet agreed delivery schedules: the time between times of placing orders to the time when the items are delivered is longer than the agreed time. This increases the chance of delivering faulty goods or even finding the customer not at home. This also needs to customer dissatisfaction. Customers would like their deliveries on time.

- Return of unwanted goods: this problem is caused by wrong deliveries. This problem is also due to the fact that deliveries are either damaged or they are delivered late. In order to avoid this, the company should ensure that the correct goods are delivered on time and in good condition.

3.3.3.2 Goals and Objectives:

In order for the delivery service to meet the required standards the problems mentioned must be solved. Thus Dan needs a service in place that meets the following goals and objectives:

1. Delivery allocation

proper planning of deliveries should be made by Dan. In this case Dan should ensure that all deliveries are correctly delivered to the right address. Deliveries should not be double booked. In this case he should try and distribute the deliveries in a way that delivery time's do not overlap and at the same time ensure that he equally distributes the deliveries to the delivery persons.

2. Delivery routing

Dan should sort deliveries based on delivery region and locations to ensure that deliveries are made within the specified time. Dan should have the ability to define customizable delivery regions, which are tied to retail store locations. Within each delivery region Dan should assign delivery men according to the amount of deliveries in that region. The delivery persons should also confirm that persons are at home in order to avoid the problem of finding no one at home.

3. Correct deliveries

Also a description of the goods to be delivered should be clearly presented to the delivery person to avoid mistakes. The service should also allow delivery persons to view their scheduled deliveries when the need arises.

Dan also has usability requirements, whereby he would like a system that is simple to use, quickly carries out tasks required and finally a system that meets his needs of delivery planning. In order to get things done quicker the system must be easy to learn. This will allow for Dan to efficiently compose a home delivery service.

3.3.3.3 Activity Scenario

On a daily basis Dan receives orders for groceries from customers. Having received these orders he must plan for the deliveries ensuring that they are delivered correctly and on time. In order to do this Dan organizes the delivery persons daily into different regions where they have retail stores. These delivery persons can be shifted depending on the amount of deliveries required in the different regions. Basically the idea is to have the deliveries within certain regions handled by the closest delivery person available. Dan also needs to do some follow up to ensure that the deliveries are delivered on time. If there is any problem such as schedule delays then Dan needs to know in good time to make provisions to reallocate deliveries.

In order to manage all these processes Dan connects to the service creation environment where he creates a service for deliveries. In this case he first specifies all the regions where the different delivery persons should be. These regions are created on the basis of the different retail stores placed in the city. He then assigns the different delivery persons regions. Then he picks the different orders and assigns them to the delivery persons according to regions.

In that if an order is for a particular region it is only assigned to a sales person in that particular region. Dan sets this in the delivery person's schedule with regard to the time when the delivery has to be made. The delivery person logs on to his schedule and can see the order and where it is to be delivered. In addition the delivery person gets a reminder in form of a message informing him to start organizing for the delivery in good time. If he/she thinks the delivery is not possible he/she will inform Dan in good time to find an alternative delivery person.

In addition Dan has set the service to give him alerts if a certain delivery is running late. The deliveries should be made at least twenty minutes before the desired time. In this case if the delivery person is not at the delivery address at the intended time Dan gets an alert. In this case Dan can enquire what the problem is and if the delivery person can still make it on time. If the delivery person will not be able to make it on time Dan informs the customer of the delay and the estimated time of the delay. If any other arrangements are required to make a successful delivery Dan ensures that this happens smoothly.

Further the customer is sent a message informing him that the delivery person is headed to his/her address to deliver the orders. This will inform the customer the time the delivery will be made and how far the delivery person is. In the case the customer will not be at home he/she can make arrangements for the order to be picked up or postpone the delivery for another time.

Dan will also be monitoring the amount of orders each of the delivery persons has and if there is one delivery person with a tight schedule while others are free, the free delivery sales persons can be relocated to help the delivery persons and assigned some of the orders.

All in all Dan should ensure that all orders taken can be delivered with the desired quality. That is they should be correct, on time and in good condition. Figure 3-7 shows the processes that Dan needs to carryout in order to successfully manage the delivery planning.

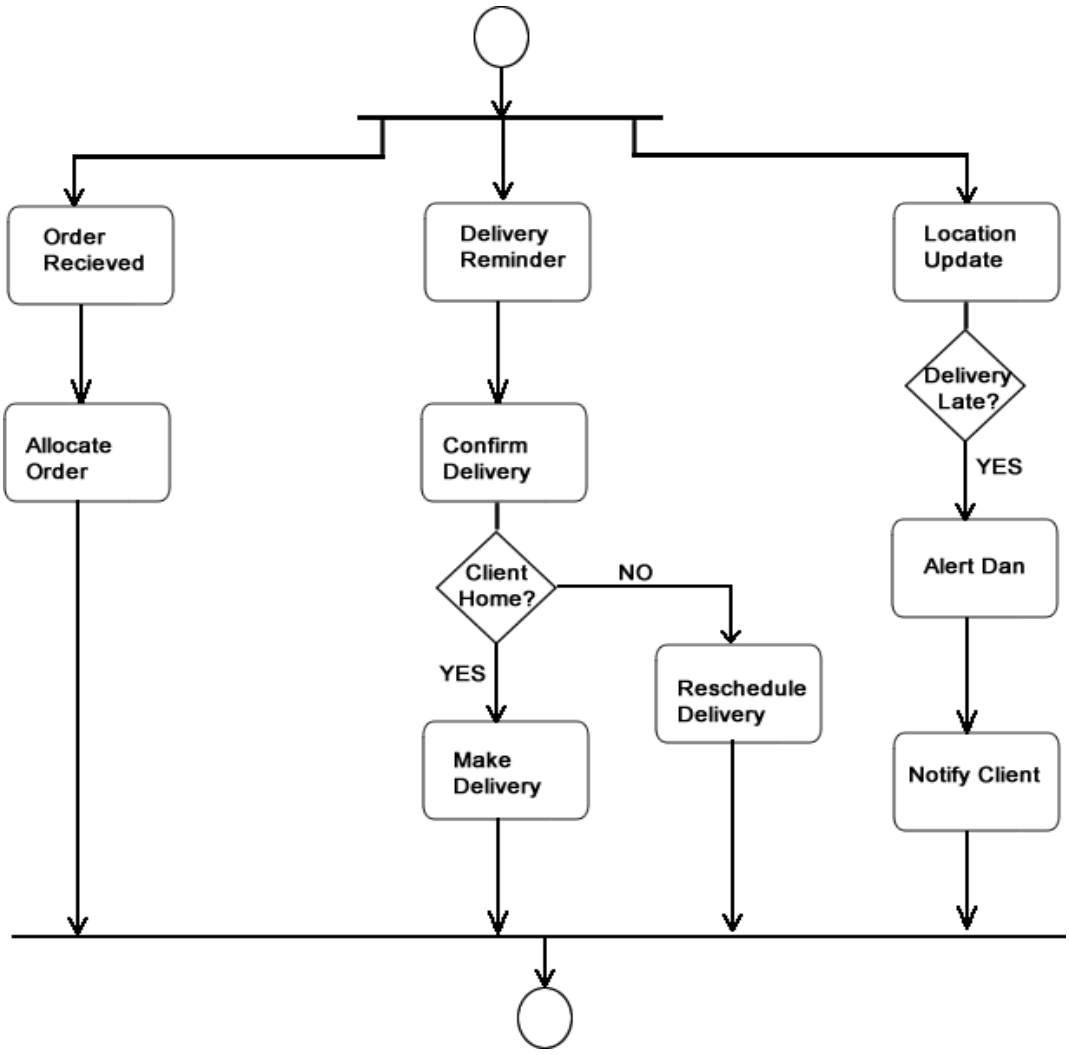

Figure 3-7 Home Delivery Scenario Activity Diagram

3.3.3.4 Composition Scenario

The need for the service arises because Dan requires a tool that can help him carry out his planning duties. As a delivery planner he has been faced with logistics problem when trying to ensure that deliveries are made correctly and at the right time. He has trouble managing deliveries in the different parts of the city as most of the time the deliveries are handled by people who have trouble getting to the delivery address due to various reasons. Dan also has problems monitoring these deliveries.

Dan is the main user of the service he is creating but also the delivery persons will make use of it. He has installed the composition software and has access to components available. Dan intends to implement the service in several steps. The first step is to ensure that delivery persons are assigned orders correctly and that deliveries are made on time and correctly.

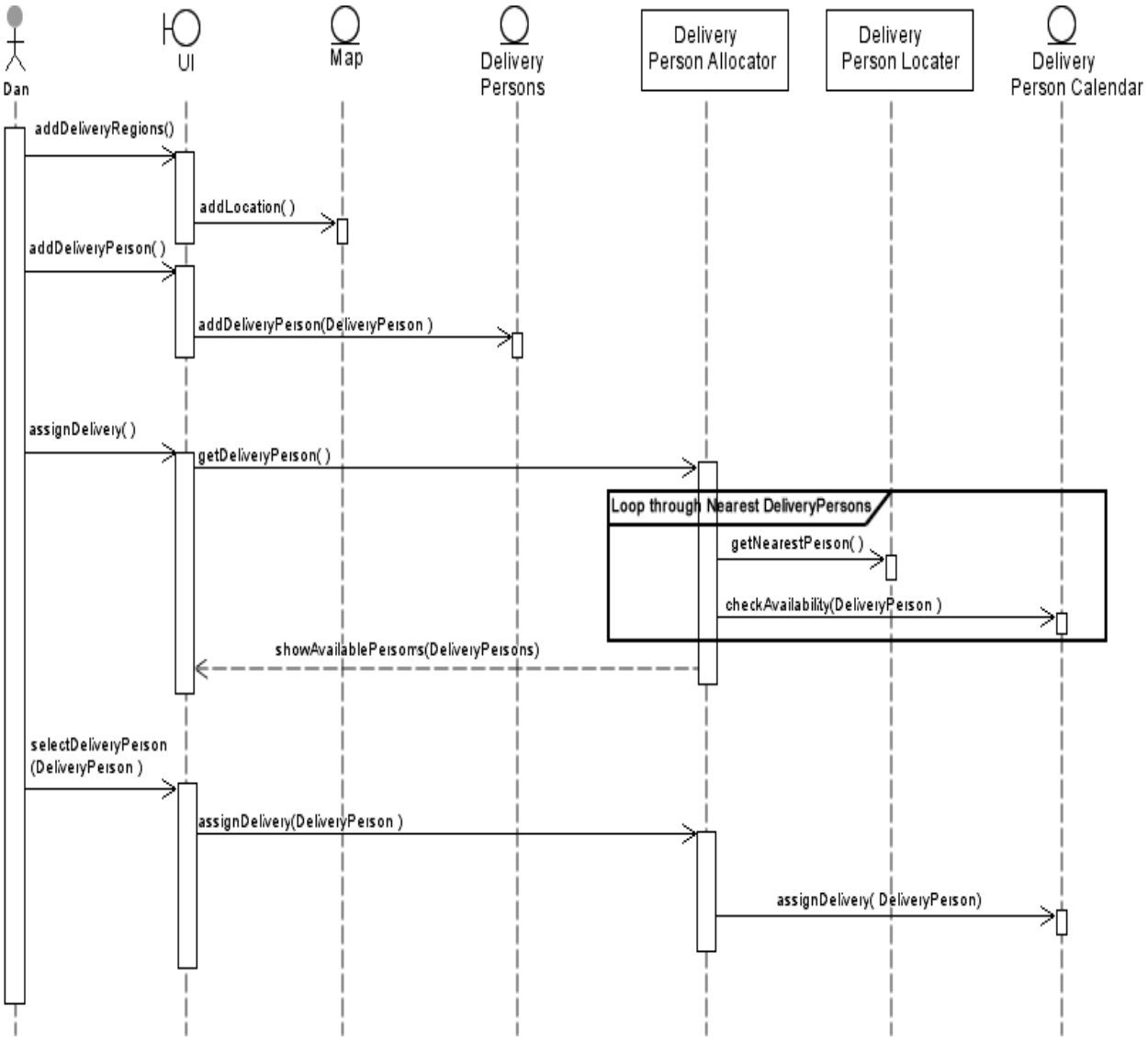

Figure 3-8 Home Delivery Scenario Assigning Deliveries

As shown in Figure 3-8 Dan first logs into the system and adds delivery persons and the regions where they will be based. Therefore when an order arrives Dan gets the nearest delivery person who is available and schedules a delivery in his/her calendar.

Figure 3-9 shows the scheduling process and how the system should react in different changes of time and location. In the schedule he sets a message to be sent to the delivery person to inform him/her about the delivery and act as an alert to ensure that the delivery person can start preparing for the delivery. In addition another message is sent to the customer informing that his/her order is being delivered. In this case the customer can call in if he/she will not be at home and postpone the delivery of the order.

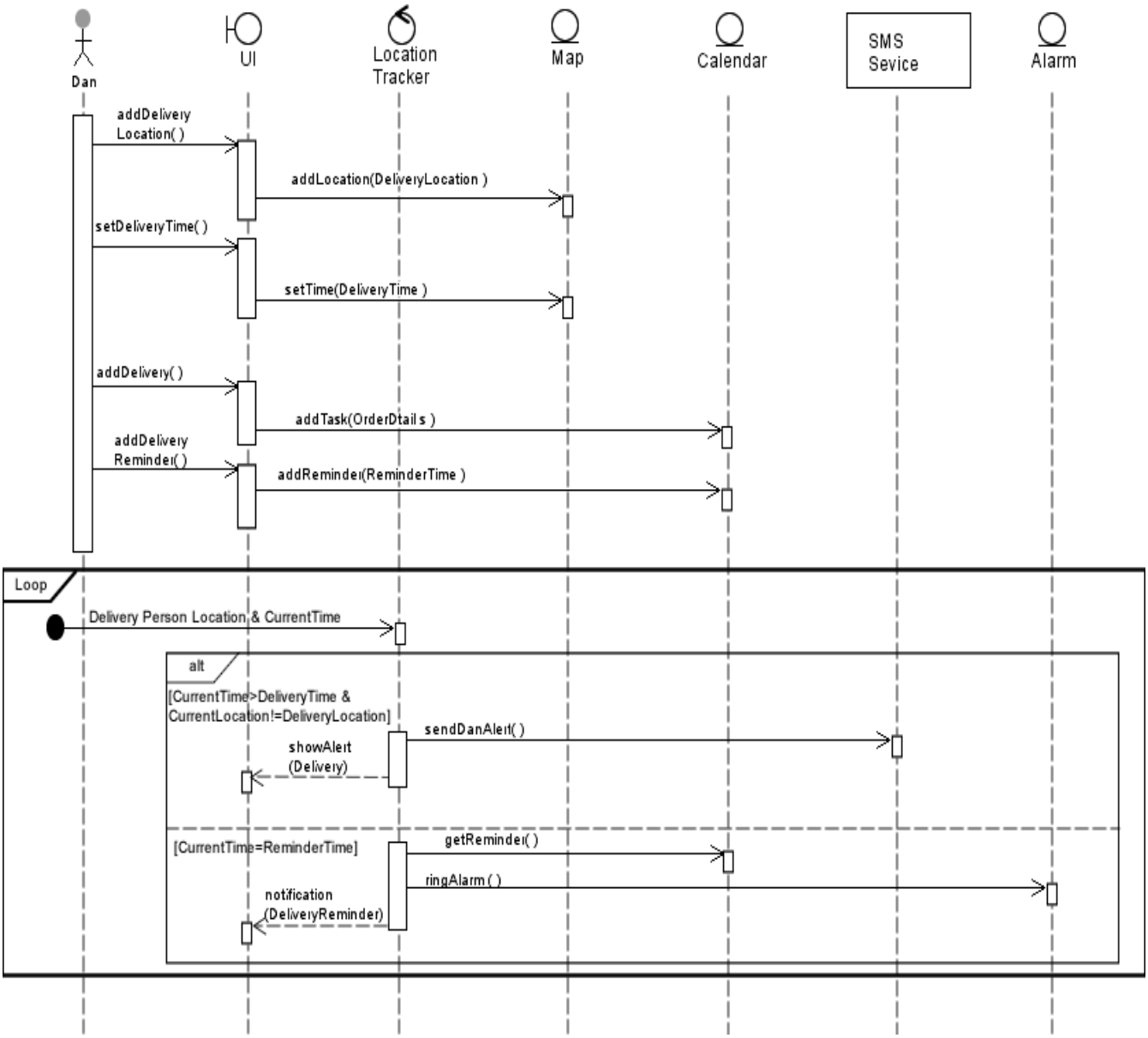

Figure 3-9 Home Delivery Scenario Scheduling Orders

In the second step Dan will set the address for the orders as locations on the map facility that he logs in. In this case when the delivery person logs in to the map, he can see the locations where he/she should make the deliveries. In addition to setting the location Dan will also set alerts to be sent if within the set time the delivery person has not reached at the desired address. The alert is sent both to the delivery person and Dan. In this case Dan can take corrective measures to ensure the delivery is made on time or inform the customer that the delivery will be late.

The final step of developing the service is whereby Dan logs into the map and requests for constant monitoring of the delivery persons. Also getting information of whether their schedules are empty. In the case there are delivery persons free they can be relocated to other regions with many orders to help out in the delivery. In addition the delivery persons are able to request traffic information to know which routes to avoid at any one time.

Now Dan can carry out the delivery planning and monitoring with a lot of ease with the help of the service that he has created. It is also making the work of the delivery persons easier in that they know where they need to be in any one time and what deliveries they should be making.

3.3.4 Busy Student Scenario

Ian creates a service to help in planning for the lectures. A mobile phone is an important tool for communication and other personal management services such as having alarms, calendar, etc. With all its advantages most users don't make the full use of this technology. In the case of this scenario the tool should help the student manage and plan his daily student related activities. The point in case is whereby a class in progress is once in a while disrupted by ringing phones, because some students forget to change their phone settings. A step by step approach is followed to compose services that will help Ian manage his/her lectures with reminders and also avoiding disruptions in class.

3.3.4.1 Problem Description

Even though mobile phones are useful tools for communication in certain areas they might be highly unsuitable due to disruptions. From an article in the Sunday Times [28] various people discuss strongly against mobile use in schools as they are disruptive. In the article they argue students do not have good phone etiquette and in many cases schools have banned mobile phones. Still we have to come up with solutions that make the use of these powerful tools minimizing their negative aspects. Many a times students need a tool to manage their time. This is probably due to the high bulk of work that the students have. In this scenario the idea is to show how the disruptive nature can be minimized and bring about the benefits that students can get from using the mobile phone as a planning tool.

3.3.4.2 Goals and Objectives:

In this scenario the goal is to ensure that Ian plans his time wisely. This is by allowing Ian to know where he should be at what time and do certain things important to his study, for instance getting reminders of deadlines as well as reminders when in certain locations to carry out certain activities. In addition Ian's phone should react according to a particular context as appropriate, thereby allowing for him to be able to avoid unnecessary disruptions when in class and at the same time giving the required notifications. The goals and objectives that he wishes to achieve are:

1. Avoid disruptions

In this case Ian would like to avoid causing disruptions while in school. This could be in his classes, while in the study areas, library as well as other areas where the ringing of the phone would be undesirable.

2. Plan his time well

In addition Ian would like to be able to manage his time wisely. He would like to meet his deadlines on time. He would also like to be reminded of certain activities that he should carry out that are related to his studies.

Ian's usability requirements are: a system that allows for quick and easy composition of services. The system should also allow for easy editing or adding services. This is will allow for him to create new services on demand. The system should thereby allow for Ian to efficiently compose a service that helps him manage his time and studies.

3.3.4.3 Activity Scenario

While in a lecture at the university, Ian's phone starts ringing loudly. Everybody turns back looking at him, the lecturer stops lecturing and says "please make sure that all phones are switched off in my class". Embarrassed Ian quickly switches off the phone thinking "this is like the third time this has happened to me this week". The lecturer finds it difficult to take off from where he left off as he has forgotten where he had left off.

Once the class is over Ian is excited that the day's activities are over and quickly heads home. While in the bus he remembers that he forgot to turn on his phone. On turning it on several messages stream in from several of his classmates asking where he was. Shortly one of Ian friend's, fellow group member in the semester's assignment, calls him asking "where are you?" Ian answers confidently "on my way home". His friend cannot hide his disappointment as they were meant to have a group meeting to finish up on the assignment as it was due the next day. After the call the Ian remembers that he had another assignment that was due on the same day, which he had planned to do but had forgotten.

It is clear that Ian has a forgetful nature and has issues with managing his time. He requires a tool that can help him manage his study schedule as well as give him reminders of due dates and other important information. His phone seems the best option as he has it always with him and can set reminders for the different tasks that he wishes to accomplish. This will inform him the due dates or times that he has to keep in mind. But this brings about another problem; because he has to have his phone on at all times he might forget to put the phone to silent mode where it might cause disruptions. Therefore he requires that all calls be automatically disconnected when in class to avoid unnecessary disruptions when in lectures at the same time the caller should also be notified that Ian is currently in a lecture by a text message. This means that the phone should contain Ian's lecture schedule. Also the reminders should go off but in a very low tone or in vibration mode when in lectures. This will allow Ian not to miss any reminders.

Ian also has been planning on visiting the library to pick up a book for the Norwegian course that he is currently pursuing. The library is on his way home but always forgets to pass by the library, probably because he is tired from the day's events and just wants to go home and rest. The phone should also contain reminders that are activated whenever he is within the vicinity of the library reminding him to pick up the book. This should allow Ian to schedule any location reminders that he needs and gets reminded when they reach the location. In addition when he is in the library his phone should at all times be on vibrate mode to avoid any disruptions while in the library.

The service processes as displayed on Figure 3-10, should avoid any disruptions while at the same time being helpful to Ian in managing his time as a student.

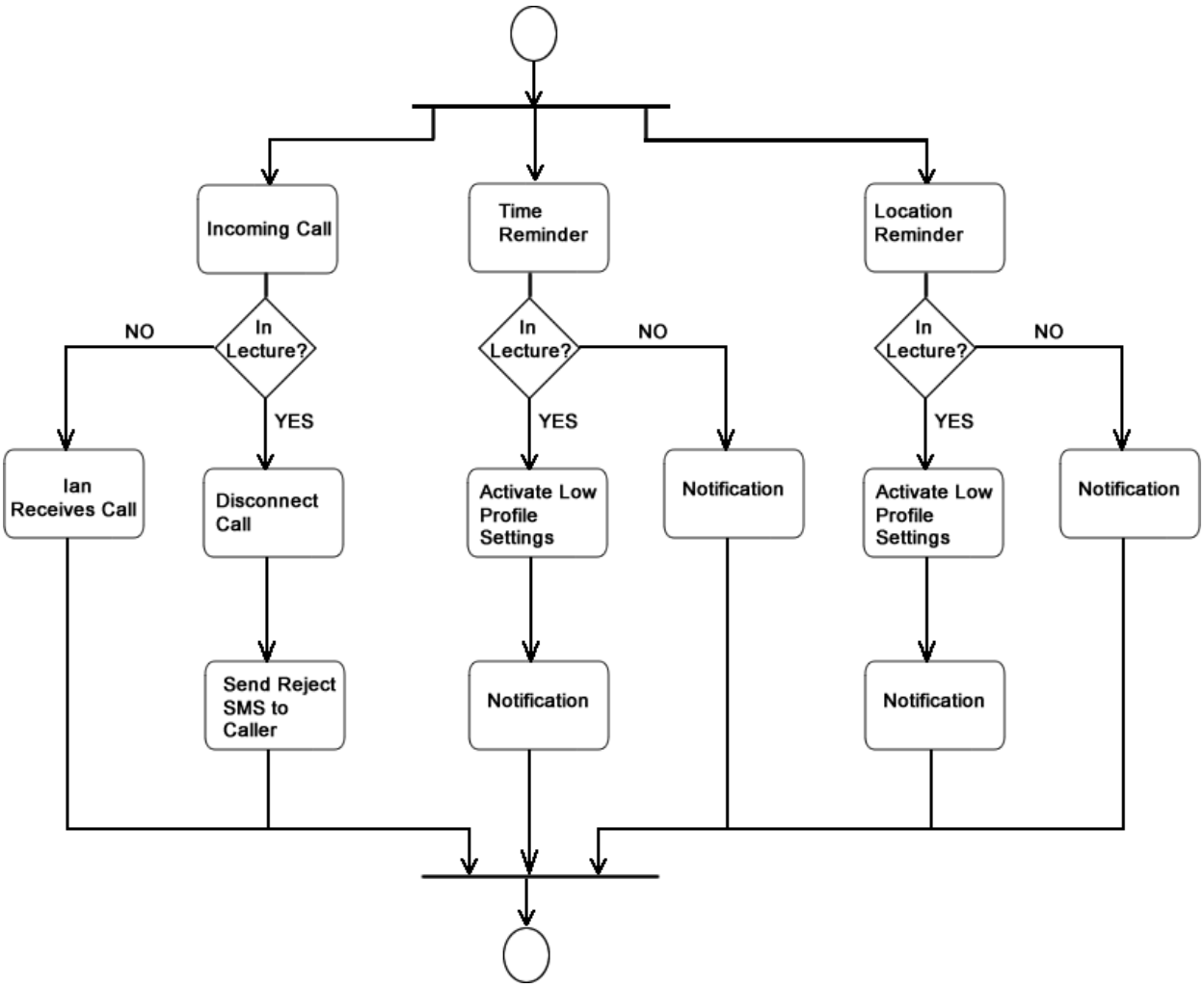

Figure 3-10 Busy Student Scenario Activity Diagram

3.3.4.4 Composition Scenario

Ian has come across a service composition tool that will help him create a service that will help him in managing his studies. His main objective is to ensure that the service will minimize disruptions while in class and other places where the phone should not ring and at the same time help him in his studies.

As shown in Figure 3-11, Ian will first log into the service composition environment and open the calendar facility. In the calendar Ian will enter his lecture schedule. In addition to setting the lecture schedule he will attach a profile to the time selected. The profile selected will be one that sets the phone on vibrate mode. This will ensure that the phone does not ring and thereby causing disruptions at the specified time. In the calendar Ian will also enter tasks that he wishes to complete, such as his assignments and attach alerts. This could be a message or an alarm to remind him of the due dates.

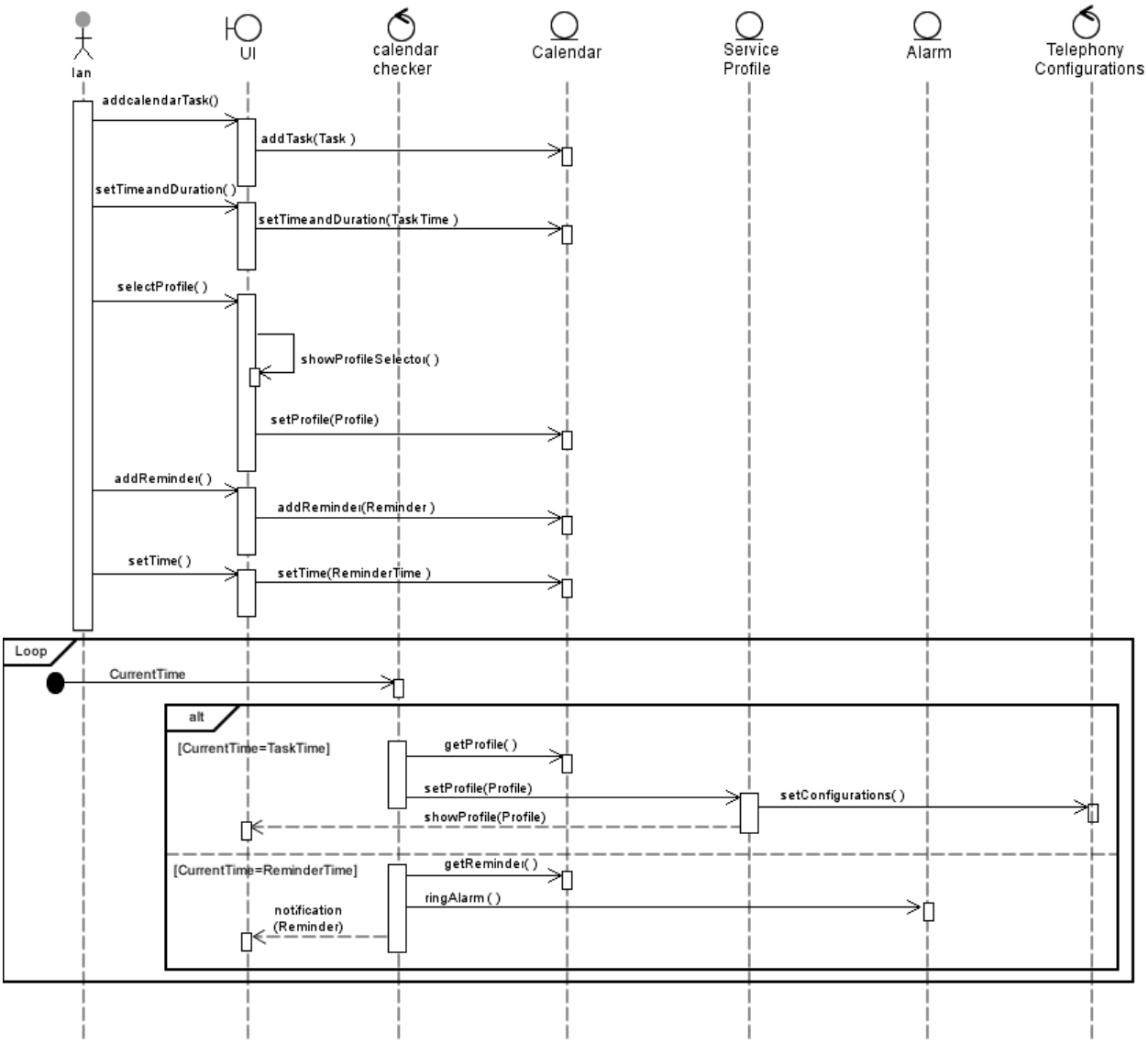

Figure 3-11 Busy Student Scenario Calendar Interaction

In order to allow for the phone not to ring in the library Ian will log into the map facility and select the address of the library and any other locations that the phone is not required to ring such as the reading rooms and classrooms and attach the vibrate profile once more. This will ensure that the phone does not ring in these locations. Finally Ian will attach alerts to certain locations such as the Library to remind him to collect a book when he is in the vicinity of the library. This is also shown on Figure 3-12.

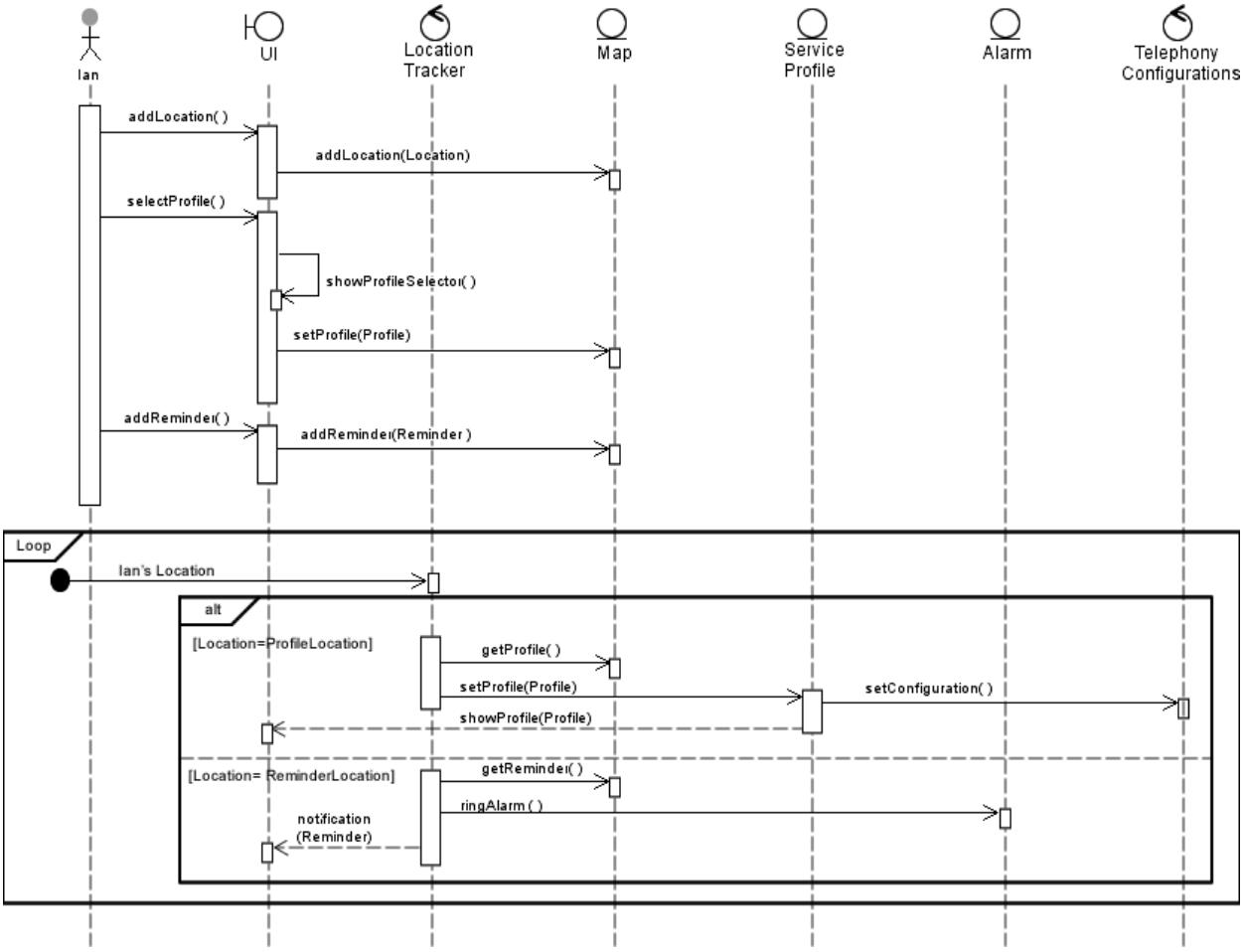

Figure 3-12 Busy Student Scenario Map Interaction

Ian can enter his lecture schedule for all his lectures in the semester within his calendar and can continually update any changes that arise or enter new tasks that he needs to accomplish. This therefore ensures that Ian will be able to manage his studies efficiently over a long period of time and at the same time in specific locations he can set certain events to occur automatically. This will help him meet his objectives.

3.3.5 Travelling Businessman Scenario

Drake has a regular routine that he follows, whereby he has a list of clients and visits each one of them periodically, for meetings. He usually telephones ahead in order to book appointments with his clients as there is a chance that the client may be out of town, or not available during a busy season. In most cases Drake finds himself poorly planning for the meetings in that he could book two appointments at the same time. Since he is a busy man Drake is always on the move and making and receiving calls to plan for his meetings thus causing a lot of interruptions during meetings. He also finds himself incurring a lot of costs mainly because of how he uses his phone. Most costs are incurred when roaming.

3.3.5.1 Problem description

Drake has a regular routine that he follows, whereby he has a list of clients and visits each one of them periodically, delivering supplies. He usually telephones ahead in order to book appointments with his clients as there is a chance that the client may be out of town, or during a busy season, not available. Since he is a busy man Drake is always on the move and making and receiving calls to plan for his meetings. In most cases Drake finds himself poorly planning for the meetings in that he could book two appointments at the same time. Sometimes when he counts on staying an hour at a client's, he finds himself loosing track of time and spending more time than intended at the clients office and misses all other appointments he had made for the day or ends up late for the other meetings scheduled which could be a bad first impression especially with the new clients.

He is also moving a lot and when outside Norway his phone is on roaming and pays a lot of money as he receives many calls that in most cases he deems unnecessary. On the other hand he cannot do without the phone because he has to coordinate his meetings with the clients. Some of the major costs that he incurs have to do with receiving of unnecessary calls, voicemail costs that he is charged double as the phone is not on unconditional call forwarding. In addition he incurs costs from the internet on his mobile while abroad.

3.3.5.2 Goals and objectives:

From the above mentioned problem Drake would like to ensure that he satisfies his customer by giving the best customer service when needed. In order to accomplish this goal the composition tool should meet the following goals and objectives:

1. Easily and efficiently plan for meetings

Drake wants to be able to manage and plan meetings with his clients well without double booking or overbooking meetings with clients. He would like to know when his meetings are scheduled to avoid conflicting meetings. He would like to know in advance his meetings in order to avoid missing meetings. In addition to avoid showing up for a meeting and finding the client is unavailable he would like to confirm the meeting with a client in advance.

2. Reduce costs

Drake phone expenses should also be minimized by having the phone react according to particular contexts, such as roaming and minimize roaming charges as appropriate. This will be accomplished by avoiding unnecessary charges by only allowing calls that are of at most importance when roaming.

In addition Drake desires a system that is highly usable that allows him to compose services easily and quickly on the move or when needed. The system should allow for creation of services with easy and few steps. The system should also be easy to learn to reduce the amount of time to compose services. The system should also be able to easily fit and meet Drake's needs.

3.3.5.3 Activity Scenario

At this particular time Drake has several old clients that he is visiting in Sweden. He has one or two new prospective clients that he believes will get into business with him and he would like to meet them. During his visit he wants to meet one of the companies that he collaborates with that helps him run minor issues on the ground when he is not close. In this case when Drake is outside of Norway all calls will be disconnected apart from calls that are on his very important list at the same time the phones internet connection should be turned off since internet is accessible virtually anywhere, from hotels and Internet cafés.

In order to plan for his meetings Drake will enter his appointments for the day in his calendar. This will make sure he does not double book meetings. In addition notifications should be sent out about an oncoming meeting in order to avoid the case where Drake forgets a meeting or overstays in a meeting messing up with his schedule.

While Drake is in Sweden moving from meeting to meeting, a client from Denmark calls Drake, but Drake is not available, and he is out of reach because he is roaming and has set the phone to disconnect instead of going to voicemail. Instead of taking a message and saving it for when the Drake is available, the call is forwarded to a collaborating company that is within the client's country. This in turn will avoid the double charge for the voicemails. Therefore the client's calls should be forwarded to the collaborating company when Drake is out of reach. In this case only the client's numbers will be forwarded and other numbers will be disconnected. At the worst case the client from Denmark should get a voice message or text message informing of the unavailability and alternative numbers where the client can get help.

When the client calls and is diverted, the collaborating company receives the call and listens to the client's problem, and determines the urgency of the case at hand. If it is urgent, the company contacts Drake and informs him of the problem. In the case where Drake might be in an on-going meeting with a client, the call is forwarded to the voicemail where the company can leave a message detailing the case and the particulars of the client so that Drake can contact the client to see how he can solve the problem. This means the company will be able to get through to Drake or his voicemail in the cases when he is busy. Otherwise, if the problem is not urgent the company will have the capacity to help the clients and thus will not have to contact Drake.

While Drake is in an on-going meeting, the phone should be on but in order to avoid disruptions during the meeting the phone should not be allowed to ring when in appointments. Drake has the option to switch between flight mode or silent mode and normal mode but there is still the chance where he misses important calls which may lead to customer dissatisfaction.

A more reliable approach is where all his appointment information is stored in his calendar. In the case where the appointment begins the phone should automatically switch to one of the customized profile which is appropriate for that particular moment, such as the phone being on vibrate when in meetings and ignoring calls or forwarding important calls to the voicemail. Notifications that a company called in and was redirected to the voicemail should also be sent to Drake. Figure 3-13 further elaborates what Drake requires in order to successfully ensure that he is able to manage his business functions.

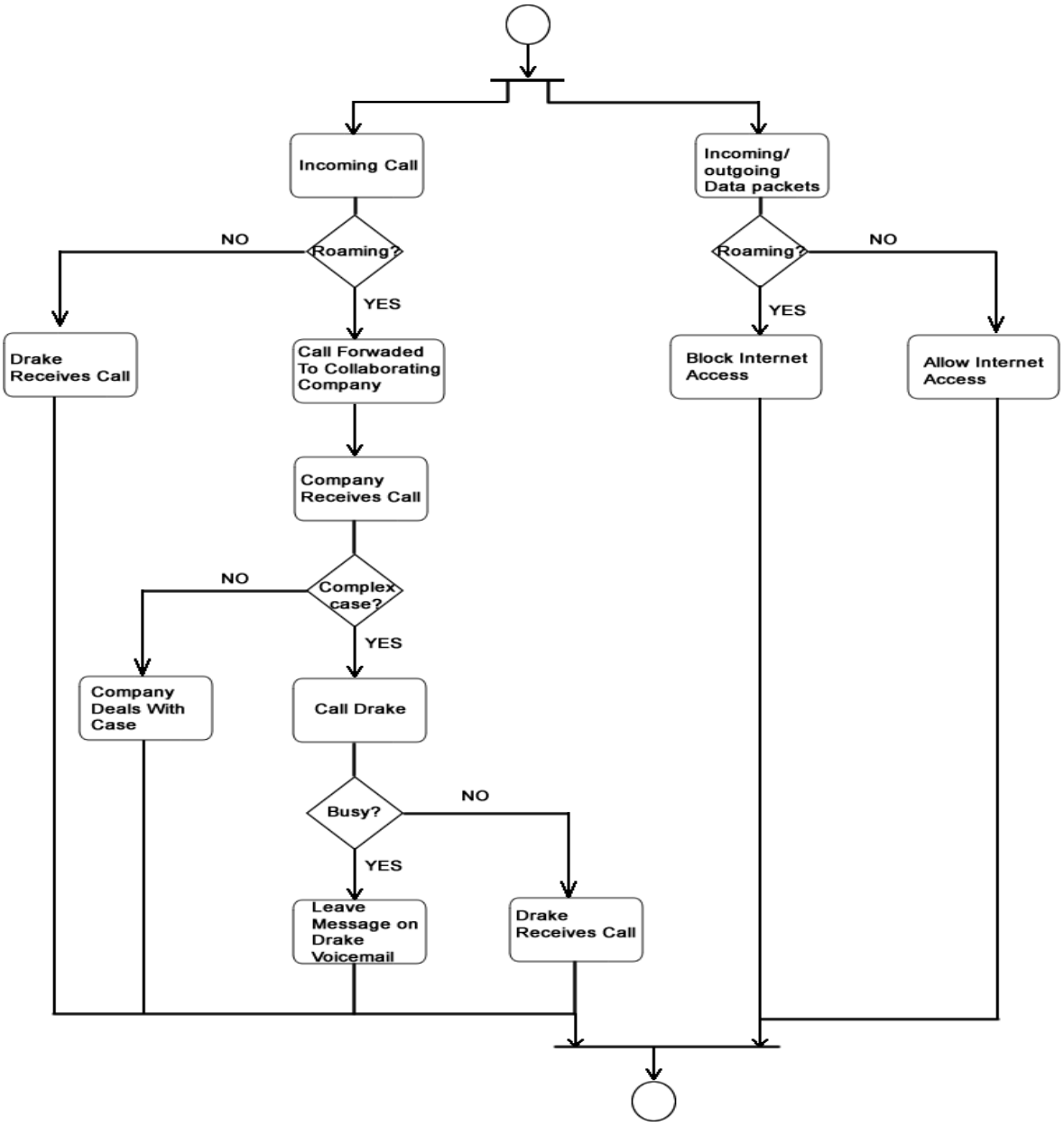

Figure 3-13 Travelling Business Scenario Activity Diagram

3.3.5.4 Composition Scenario

Drake will create a service that will help him plan for his business trip. His objective is to schedule all the days meetings well. While he is out of the country he would also like to control his phone usage to reduce his roaming charges.

Drake logs in to the service creation environment in order to create a service to help in managing his daily meetings. He first logs into the composer that composes telephony services. Here he finds components that will define how the telephone will behave. He selects a filter in which he specifies the collaborating companies' numbers which should always contact him at all times apart from when he is in meetings where their calls will be diverted to voicemail. In order for the service created to know he is in a meeting he will sets checks to be made on the calendar to identify if he is busy in a meeting or not. In addition he sets another filter for his clients'. The clients' filter will allow calls only when he is not roaming but divert their calls to the preferred collaborating company when he is out of the country. He also sets messages to be sent to all other callers informing them of his absence and when he will be available. Finally he gets the component that specifies the phone settings and sets data services off.

When Drake has set up his filters he then logs in to his map facility in the same service creation environment and sets where the filters should work. In this case he searches for Norway and specifies that when he leaves the country the composed service should start working. Figure 3-14 shows how the interaction between Drake and the system based on the set location. Whereby the composed service starts working when Drake is outside of Norway.

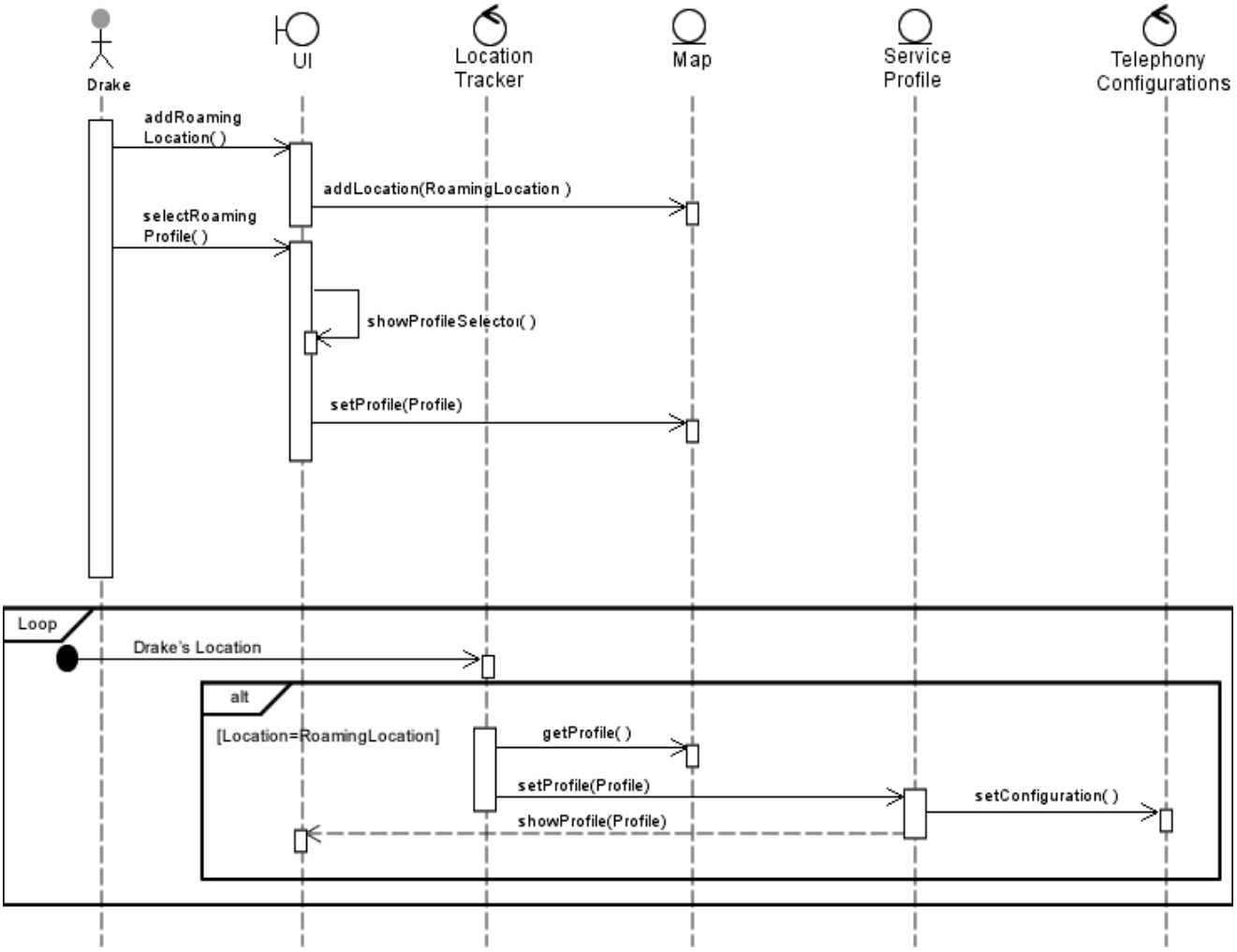

Figure 3-14 Travelling Businessman Scenario Location Based Interactions

Finally he opens his calendar facility on the same environment and set when his meetings should take place and sets alerts to remind him of the meetings. Figure 3-15 the interaction between Drake and the calendar and how the system reacts to the changes in time.

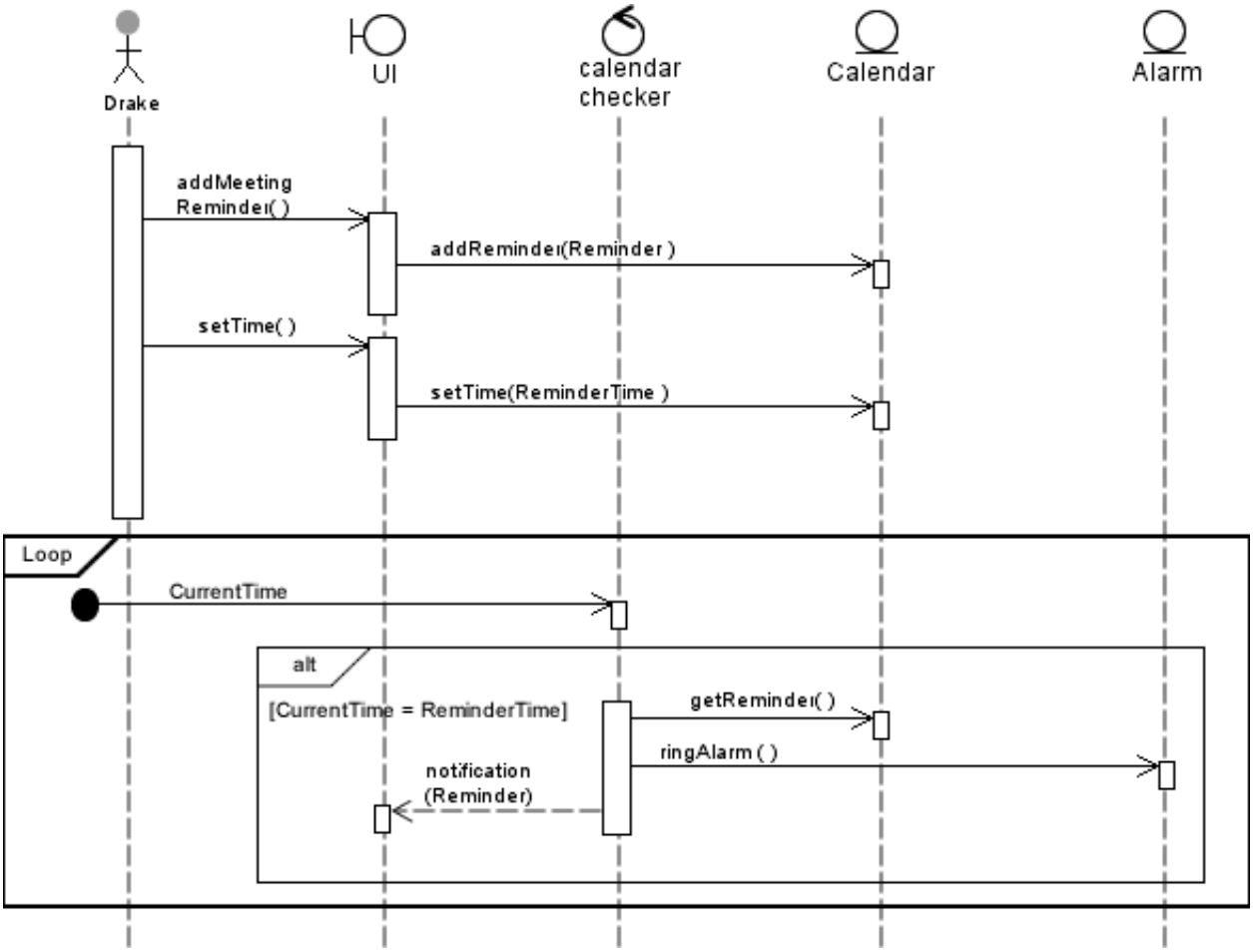

Figure 3-15 Travelling Businessman Scenario Calendar Interaction

Having created his service he can go for his business trip and expect that everything works as intended without him manually changing the phone settings all the time. He therefore can manage his meetings and reduce his phone charges.

4 Service Composition Tool

The main focus of the Master Thesis is the creation of a tool that enables the end users to compose their customized services. This chapter begins by describing the existing tools in section 4.1. It identifies a set of composition tools that compose telephony services which have evolved from the Easy Designer described in section 4.1.1 to the Easy Droid and the Easy Composer described in section 4.1.2 and 4.1.3 respectively, which are two separate applications that work hand in hand to help in end user service composition. Section 4.1.4 describes the Easy Composer with the calendar which was the latest version of the tool before the Master Thesis work.

Section 4.2, focuses on the further development done on the Easy Composer with calendar and the Easy Droid. It describes the infrastructure that was created during the Master Thesis work that is the Easy Composer with the calendar and map application. Section 4.3 describes the different components found in this new tool and section 4.4 makes an in depth look into the xml that represents the compositions. Finally section 4.5 looks at the usability features that have been incorporated into the Easy composer with calendar and map tool.

4.1 Existing Tools

The existing tools include the Easy Designer, Easy Composer, Easy Droid and the Easy Composer with a Calendar. The Easy Designer is a composition tool that allows operators to compose services for their clients. The Easy Composer allows for the end user to compose their services using service components and export them as an xml that is deployed on the Easy Droid as compositions. The Easy Composer with calendar is an extension to the Easy Composer that intends in making service composition more practical by incorporating a calendar. It allows the addition of the time context in compositions.

4.1.1 Easy Designer

Easy designer is a service composition tool that allows operators and service providers to assemble services from a palette of core capabilities where service flows can be created or modified to meet the needs of each client. The operators and service providers are able to offer service customization capabilities to meet the individual needs of their clients.

The java based application can design and assemble new services on-the-fly, in a fairly short time, greatly reducing time to market and enhancing operator agility. Operators can both innovate within their markets and respond more rapidly to demand and competitive threats. New services can be launched rapidly and at low cost, reducing the risk of service delivery. The limitation of the easy designer is that it is intended for service providers and operators. End users cannot compose their services without going through the operators

4.1.2 Easy Droid

The Easy Droid is an application developed for the android phones. The Easy Droid's architecture shown in Figure 4-1 shows how the different parts work together. It is made up of different components that make use of services available in the android environment. It contains different components such as the Notification Component. These components make use of the inherent services in the android software stack, such as the GPS. The components are further combined to form composite services, this is defined in the XML developed by the Easy Composer which is described in the next section. The Engine controls how the services are invoked and coordinated.

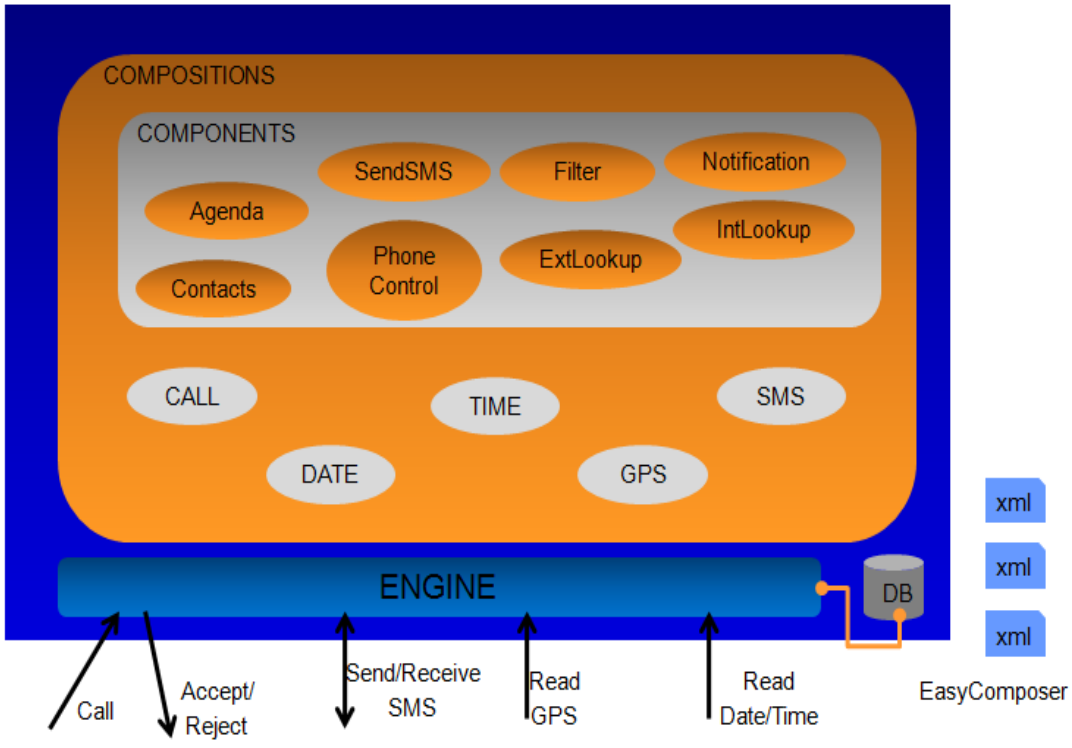

Figure 4-1 Easy Droid Architecture.

Figure 4-2 shows the two screenshots of the Easy Droid, which shows the compositions as well as the particular settings for a partiular profile.

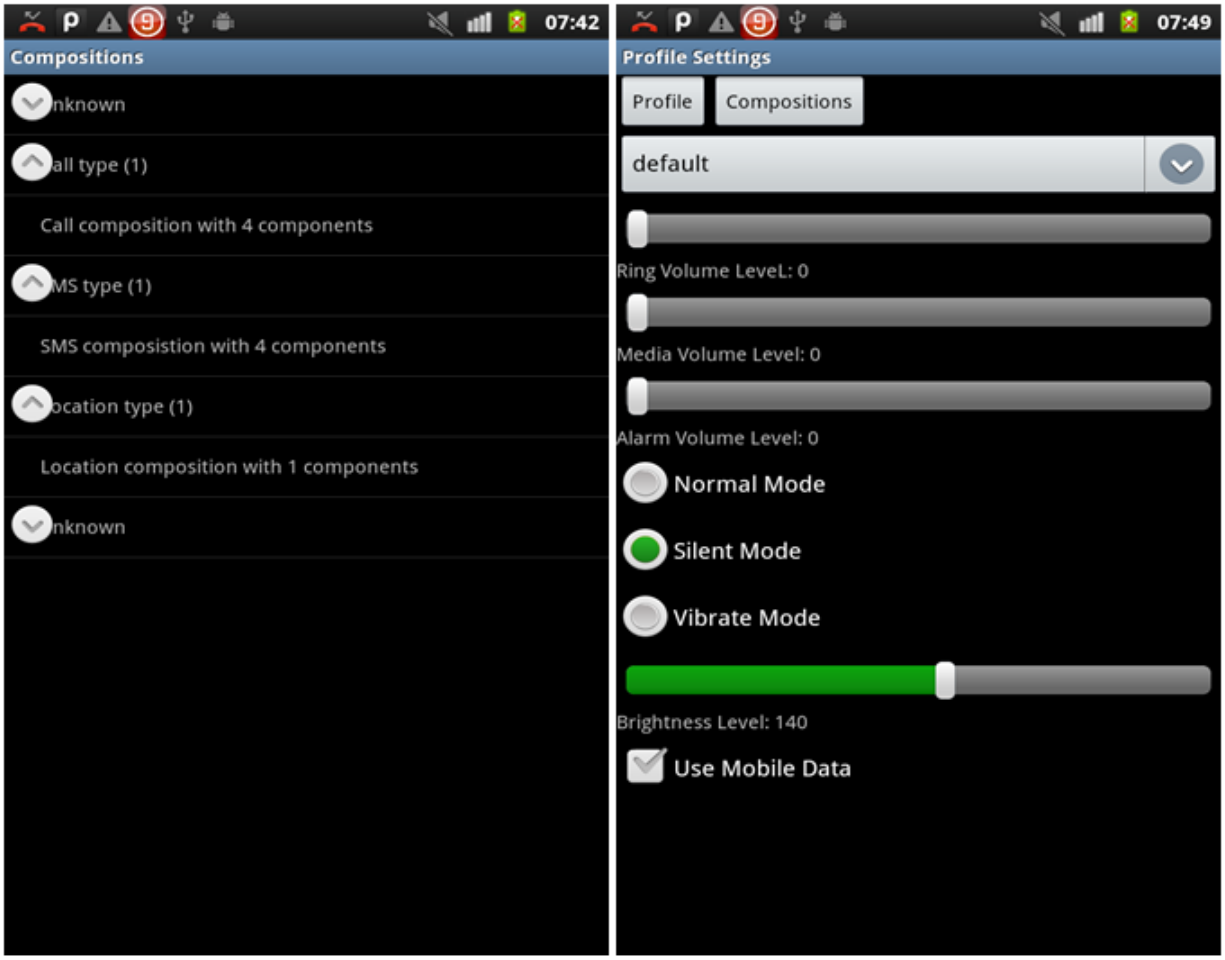

Figure 4-2 Easy Droid

4.1.3 Easy Composer

The Easy Composer brings more power to the end user by allowing him/her to customize services as needed, removing reliance on the operator or service provider. It is a graphical tool that allows for creation and modification of services. It contains a palette of components that allow for Service composition by creating service flows as shown in Figure 4-3. The components in the palette are components that exist in the Easy Droid.

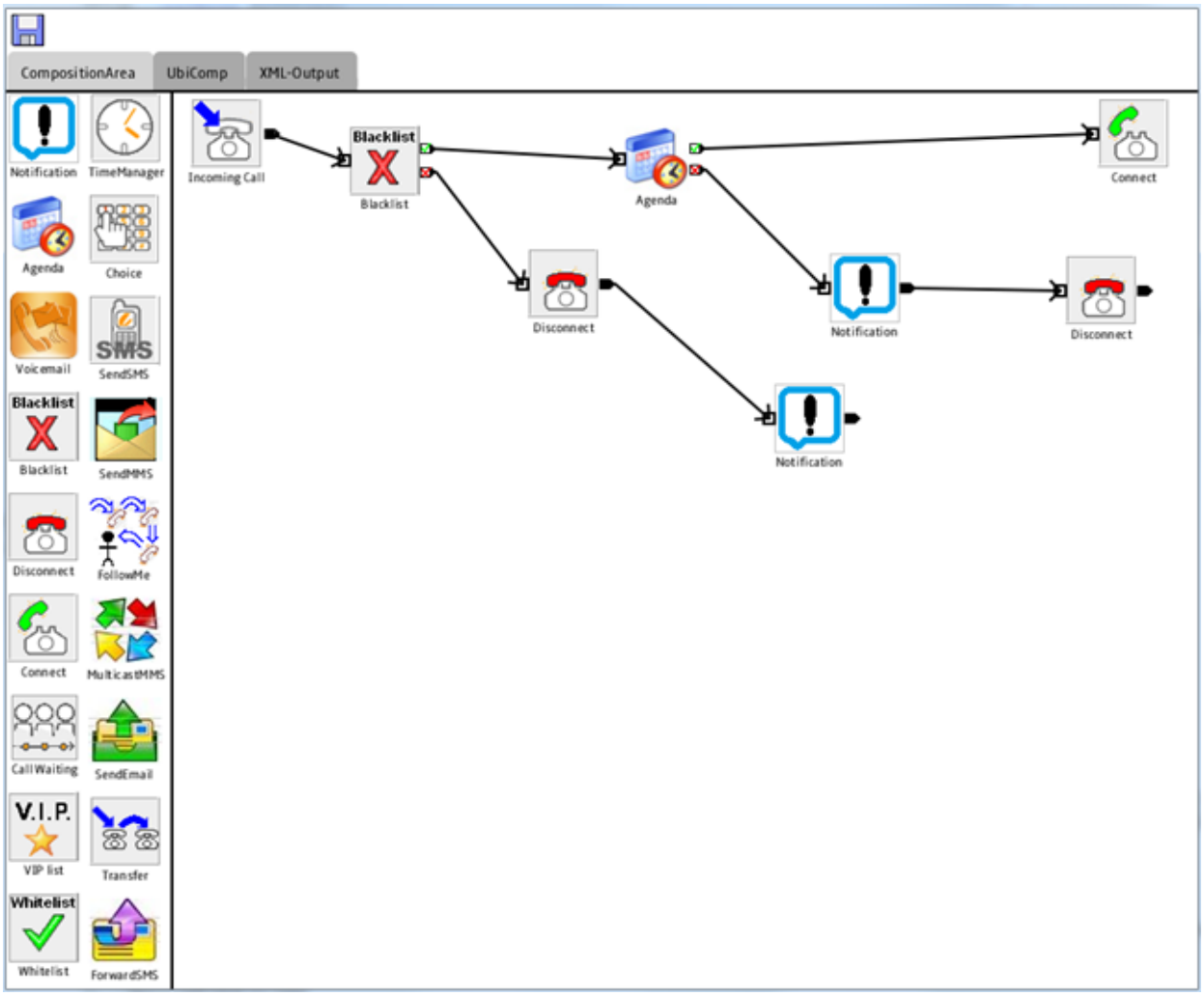

Figure 4-3 Easy Composer

Therefore the Easy Composer allows for end user service composition and then these compositions can be instantly deployed to the android phone that is running the Easy Droid.

4.1.4 Easy Composer with Calendar

The Easy Composer and Easy Droid make the composition of telephony services by end users much easier when compared to other existing end user service composition techniques which require programming and technical skills. The only limitation is that the Easy Composer is not attached to a context in which end users can relate to. In addition Easy Composer focuses on very few services whereby new services can be developed to enrich the user experience and create richer services.

In order to put things into context that all users can relate to a calendar application is developed whereby the users can log activities that they choose to carry out at certain times and in addition user profiles are attached to these activities when they are scheduled. The idea is to encode contextual information in the user profile, which consists of user preferences and service compositions. Therefore the user in this case will be presented with an application which contains a calendar tab in addition to the composition area tab that was present in Easy Composer as shown in Figure 4-4.

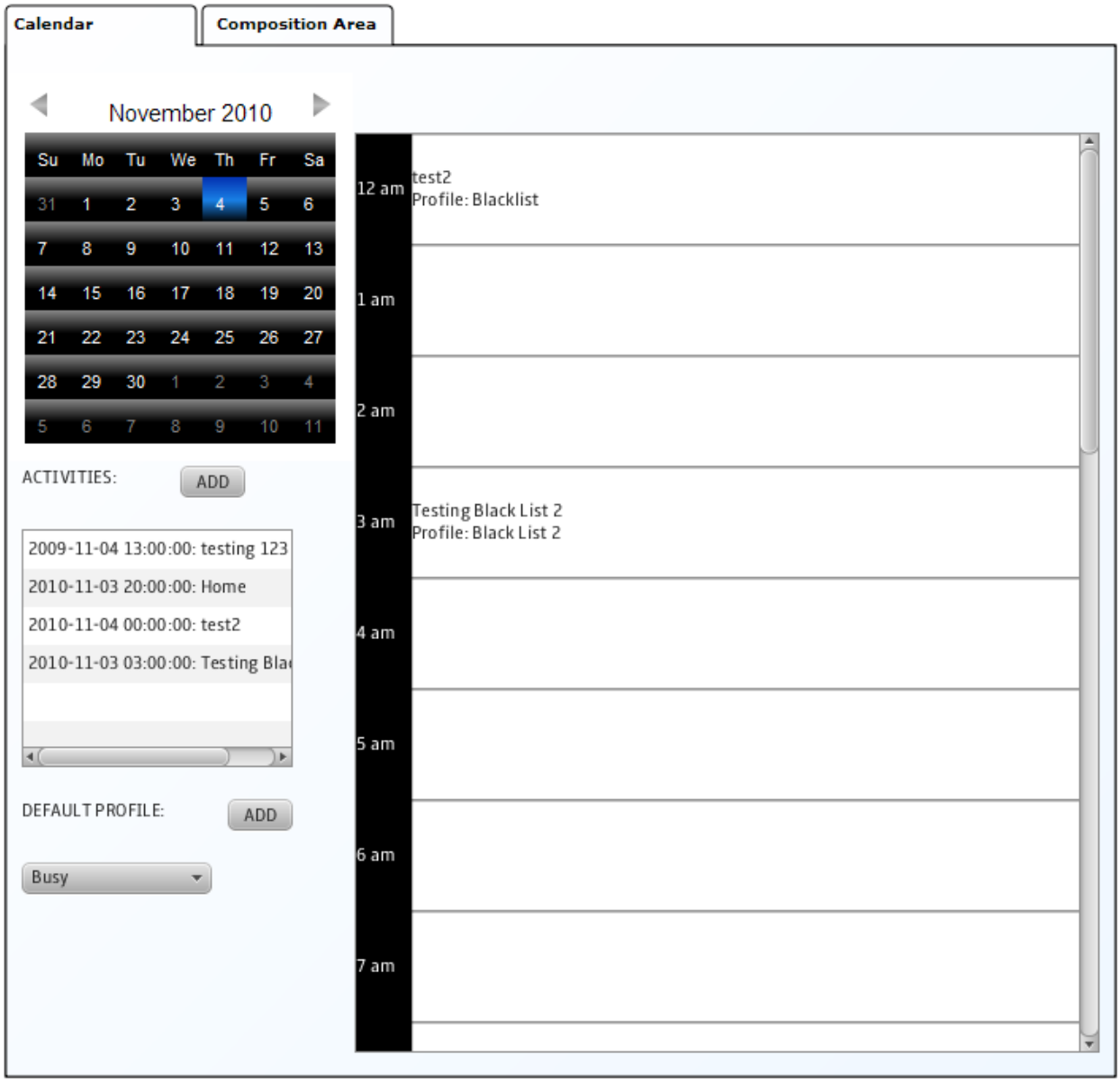

Figure 4-4 Easy Composer with calendar

The figure shows an entry of activities that the user has entered and the profiles that the user has attached to the particular activity which will be activated at that particular time. In addition the user also selects the default profile which is the composition which will be running at all other times when there is no activity scheduled. The user composes his/her services at the composition area as shown in Figure 4-5 and saves the XML output as a profile.

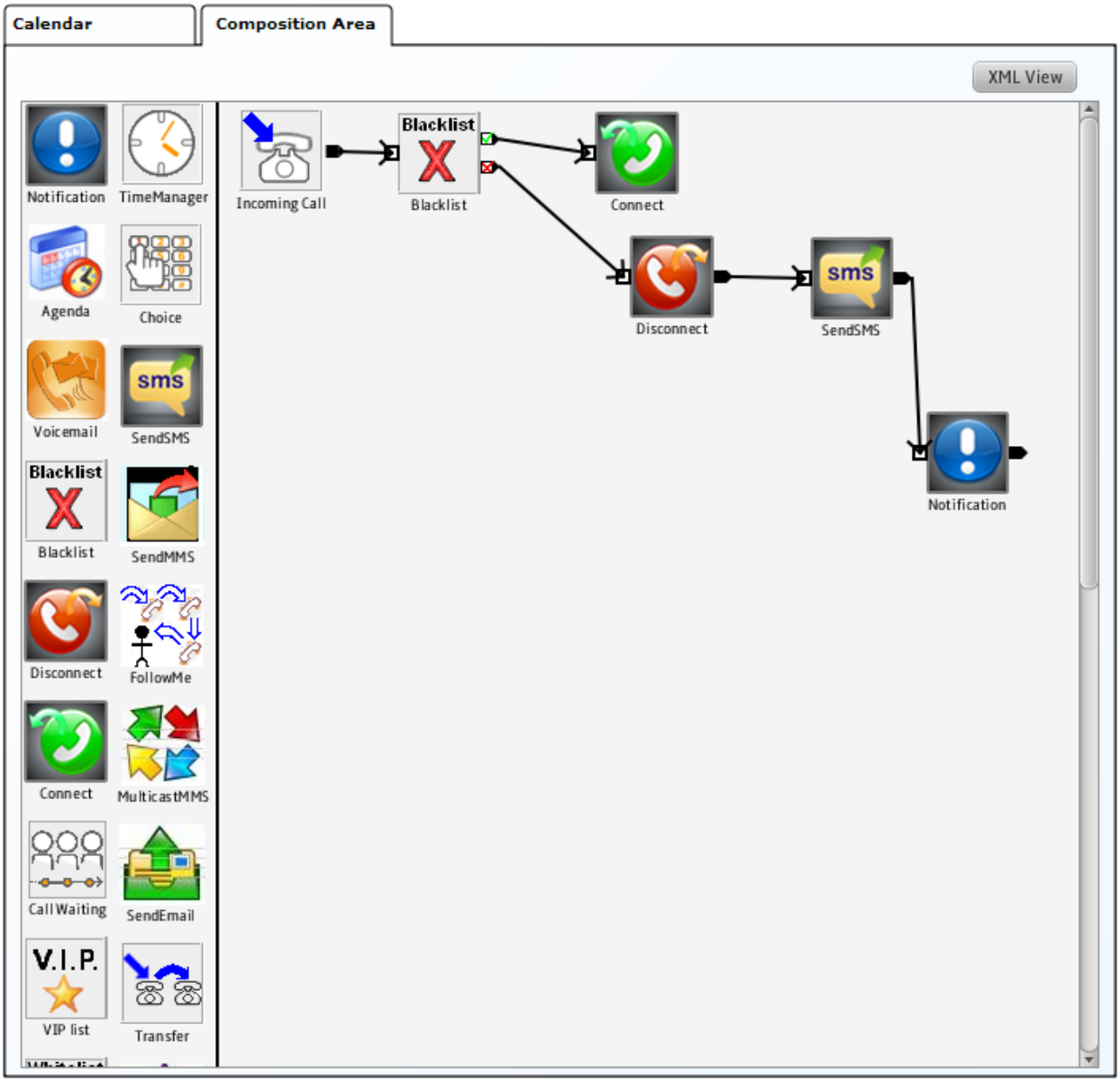

Figure 4-5 Easy composer with calendar service composition area

When the user has finally finished composing all the services and entering the activities and their active profiles he/she will then export an XML file that contains all the activities and compositions at the specified times.

This will then be fed into the Easy Droid and the engine should be able to coordinate the different compositions to run at different times as specified in the XML output.

4.2 Easy Composer with Calendar and Map application

The easy composer with calendar application was able to add contexts to the easy composer by introducing the concept of profiles and a calendar to allow for the tool to react to the user's context. The implementation of the calendar had a realistic approach toward end user composition in that it allowed for the user to incorporate his daily events when composing services. This approach allowed the user to see the importance of composing services. This led to the need to attach more user context as depicted by the scenarios.

The easy composer with the calendar was therefore extended to incorporate the user's location. The incorporation of the location context also required a form of conflict resolution because combining both time and locations would lead to conflicts. Furthermore there were inherent usability problems present in the calendar application. There was therefore a need to improve on the usability of the application.

In addition there were problems with how the different parts of the infrastructure were able to work together. This was mainly because of the XML being produced by the calendar application which made the output of the overall system inconsistent with what the user had composed. Therefore the XML was also improved to get rid of this problem.

The tool in this case to be created incorporates a map, calendar and the service composition area. This tool is created with usability principles in mind. Once the user logs in the user is presented with a calendar, map and composer tab. Within the composer panel the user can compose telephony services which can be attached to a particular time on the calendar or the map as a profile.

Figure 4-6 shows the composer area where the user can compose their services. When the user finishes composing the services he/she saves the composed service both in a database as well as his local drive. The database allows for the user access his compositions from different locations allowing for portability.

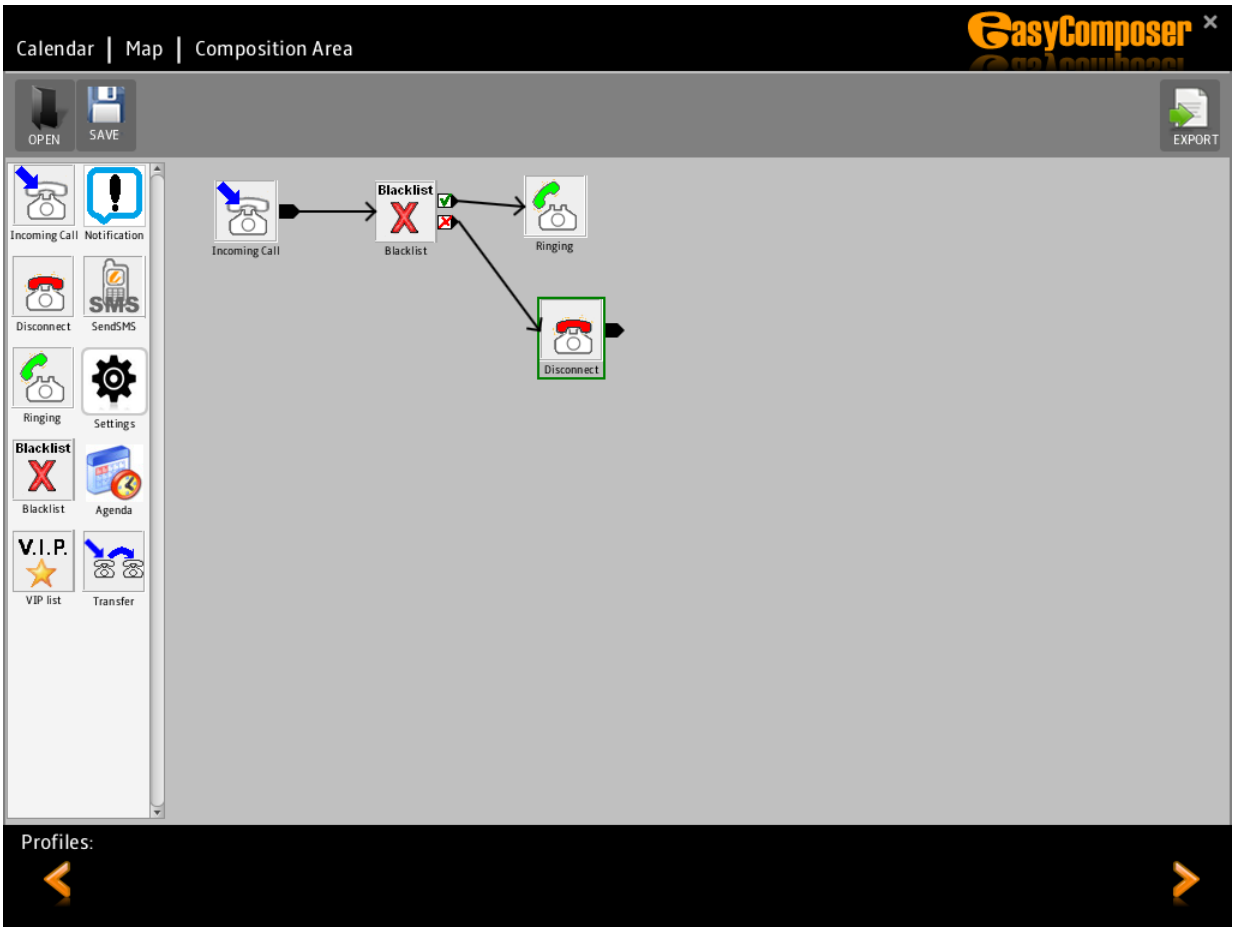

Figure 4-6 Easy composer with calendar and map, composition area

The calendar panel shown on Figure 4-7 will then allow the user to enter their tasks. In addition to entering the tasks the user can attach a profile to the time. The figure shows how apart from adding profiles to tasks entered the user can also specify the location in which these tasks will happen. In this case the context can contain both location and time.

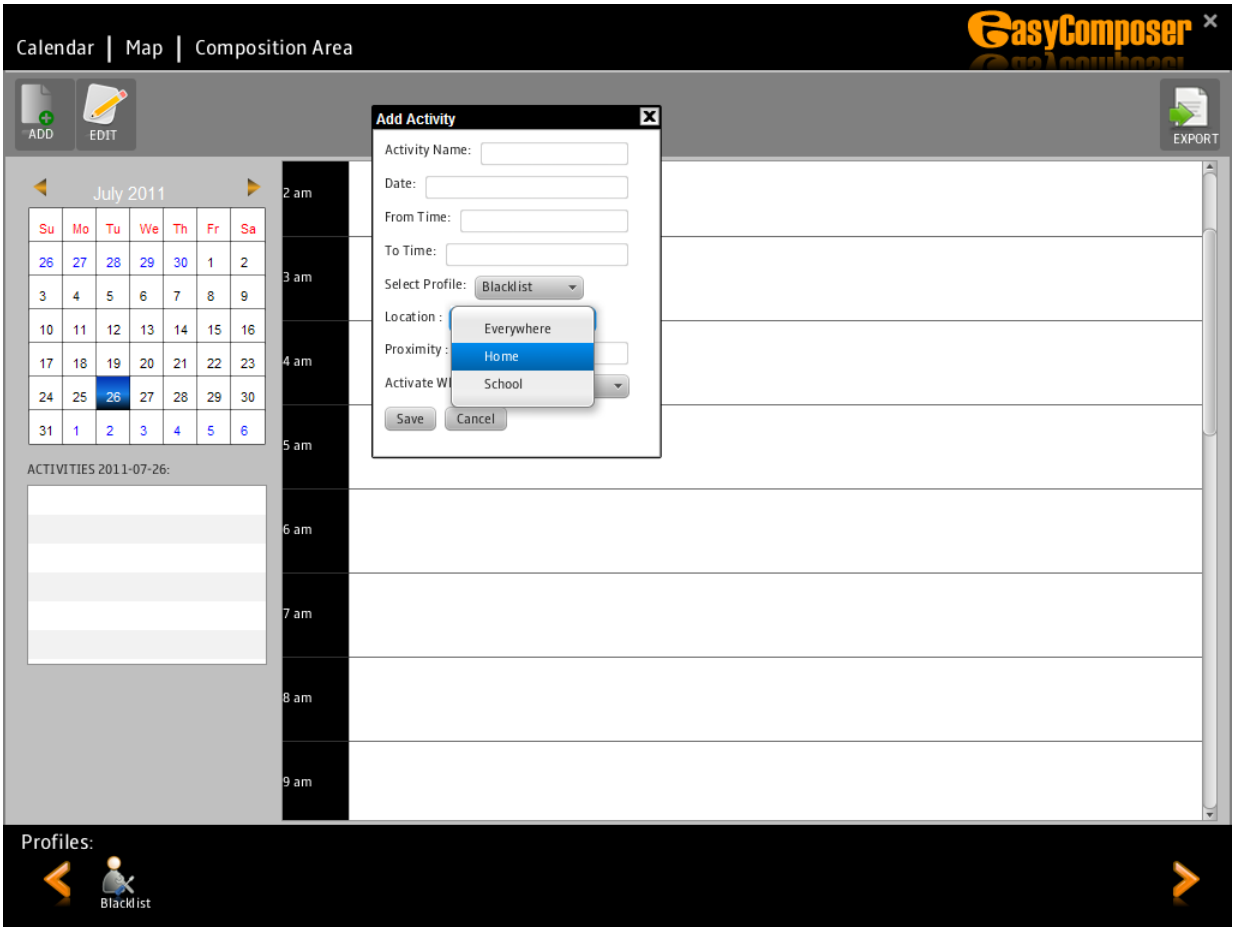

Figure 4-7 Easy composer with calendar and map, calendar panel

The map area allows for the user to define his/her locations. Further the user can attach a profile within this location. In addition the user can add the time in which the particular profile should work within that particular area. Figure 4-8 shows the map panel and how the locations are viewed within this tab as well as how profiles can be attached.

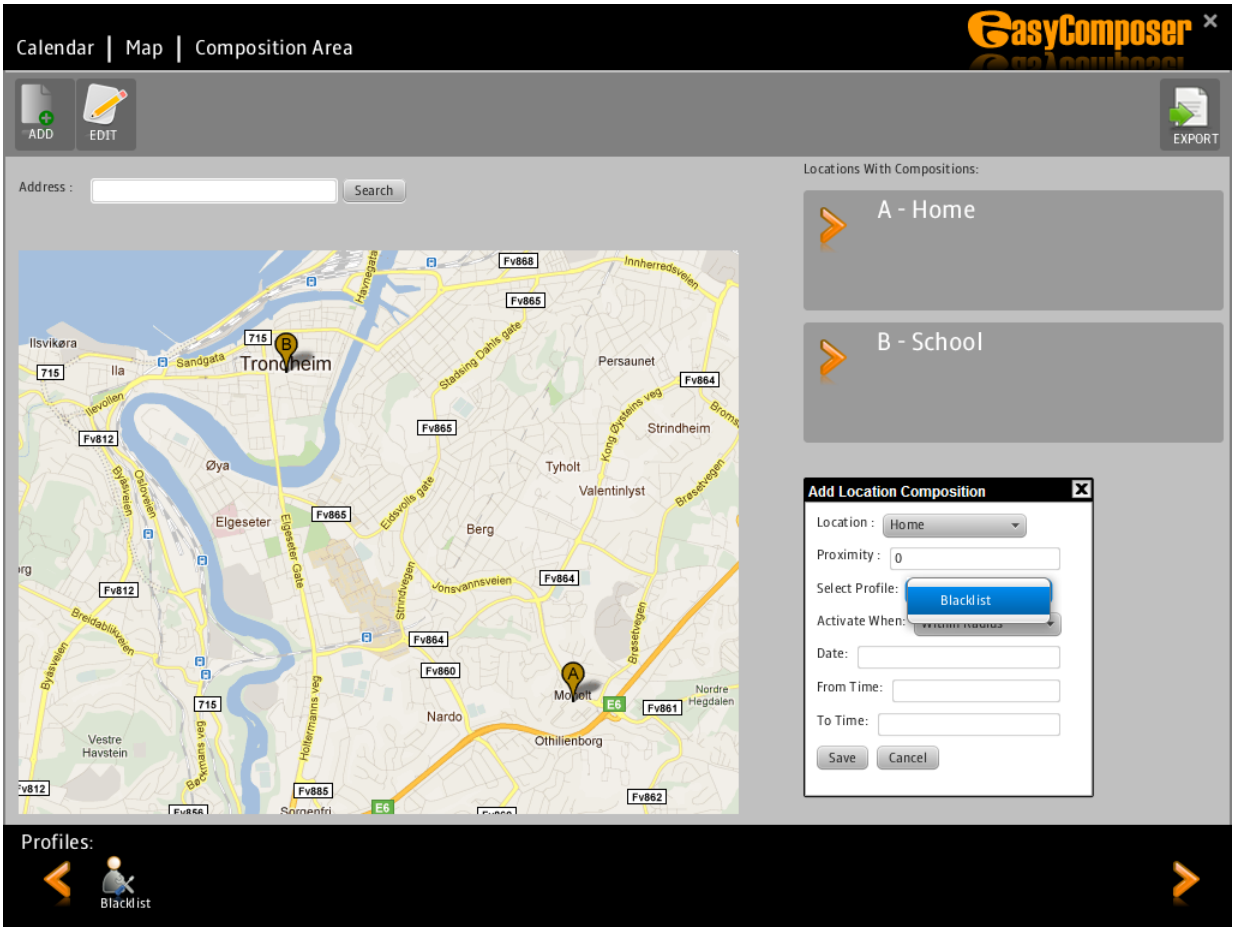

Figure 4-8 Easy composer with calendar and map, map panel

Once the user has finished composing his/her services the user can click the export button which sends the xml produced to an online server. This exported xml can then be downloaded to the user's phone. Therefore the xml is exported with the user's information to allow the phone download the correct xml. In addition the user is presented with several other icons that allow him/her to customize his/her compositions.

4.3 Basic Components

Telephony services have been developed in the concept of components. Where, these components allow composing of basic telephony services. These components are presented as graphical icons on a palette in the composition area. The major components in the composition area include:

- Agenda component: which allow for users to specify the availability of users, this is according to the activities they will be carrying out at a particular time according to the calendar schedules. For instance if the user is in a meeting the incoming calls will be disconnected while allowing the calls when the user is not busy.

- SendSMS component: allows for users to send SMS messages as and when needed. For instance in the case a caller is disconnected, the SMS component can send a message to this caller telling him/her reasons for the disconnection.

- Filter Components: These are the Blacklist component and the V.I.Plist component. The Blacklist contains all the numbers which should be disconnected when they try to connect with the user. On the other hand the V.I.Plist is a list of all numbers that will go through when the user is in mode which does not allow any incoming calls (busy).

- Notification component: notifies the user of certain actions that have taken place in the background. For instance if a call is disconnected, the user will not know that this has happened. The notification component allows the user to know of these events.

- Settings Component: This component is simply meant to capture the settings that the user wishes to be active when a particular service profile is being executed. For instance the ringer volume level, if vibrate is on or off and so on. This allows for the control of the terminal, therefore this can be looked at as the terminal profile.

- CallTransfer Component: As its name suggests this component basically transfers a call to another number. For instance it diverts the call to another number or a users voicemail number.

- CallControl Components: These are the components which define the call actions basically these components are the IncomingCall component, the ConnectCall component and the DisconnectCall component. This dictate what happens to an incoming call.

These components help in the process of composing telephony services in the composition area.

Within the map and calendar there exist two virtual components which are equally important but they cannot be directly mapped to the Easy Droid components. These components include:

- Location Component: In the map there is the location component which defines the locations that is the location's coordinates and radius.
- Task Component: Within the calendar area there is a task component which defines different tasks the users should carry out and at what time.

4.4 XML representation

When the compositions are created they are exported as an XML that is deployed to an online server. The Easy Droid on the phone then downloads the XML that was exported to the server. In order to ensure that it is the right XML that is downloaded the XML is saved with the users number tagged to it. This number is specified when logging into the system. This XML file is read by the engine and executed. A structure was developed of how this XML should look like. The structure of the XML is as shown below:

```
<Compositions>
<!--    CompositionTypes                                    -->
<!--    public static int CALL_TYPE = 1;            -->
<!--    public static int SMS_TYPE = 2;             -->
<!--    public static final int LOCATION_TYPE = 3;          -->

<!--    ComponentTypes                                                          -->
<!--    private static final int FILTER_COMPONENT = 1;                  -->
<!--    private static final int CALL_CONTROL_COMPONENT = 2;                    -->
<!--    private static final int AGENDA_COMPONENT = 3;                          -->
<!--    private static final int PROMPT_COMPONENT = 4;                          -->
```

```
<!--	private static final int SMS_FILTER_COMPONENT = 5;			-->
<!--	private static final int SEND_SMS_COMPONENT = 6;			-->
<!--	private static final int LocationFilter_COMPONENT = 9;			-->

<!--	CallControlComponent actions:		-->
<!--	public static final int IGNORE_CALL = 1;	-->
<!--	public static final int RING_CALL = 4;	-->

<!--	FilterComponentMatchTypes			-->
<!--	public static final int EXCACT = 1;		-->
<!--	public static final int PREFIX = 2;		-->
<!--	public static final int SUFFIX = 3;		-->

<Composition type="1" id="0" name="Call Composition" firstCid="0" priority="0">
 <Criterias>
   <Criteria>
        <Time  id="2" name="Time2" fromTime="20101126 1200" toTime="20101126 1200"/>
        <Location  id="1" name="Location1" longitude="" latitude="" radius="" activate=""/>
   </Criteria>
   <Criteria>
        <Location  id="2" name="Location2" longitude="" latitude="" radius="" activate=""/>
   </Criteria>
   <Criteria>
        <Time  id="2" name="Time2" fromTime="20101126 1200" toTime="20101126 1200"/>
   </Criteria>
 </Criterias>

 <Component type="2" cid="0" name="Reject" nextCid="1" action="1" />
 <Component type="6" cid="1" name="Send SMS to rejected" nextCid="-1"      textMessage="You're
rejected!" toggleButtonIsChecked="1" />
 <Component type="9" cid="2" name="LocationFilter" nextCidIfMatch="-1" nextCidIfNoMatch="-1"
radius="0" latitude="0" longitude="0"/>
 <Component type="1" cid="6" name="Blacklist!!!" nextCidIfMatch="1" nextCidIfNoMatch="2"
matchType="1" />
 <Component type="3" cid="4" name="Agenda" nextCidIfBusy="0" nextCidIfAvailable="6" />
</Composition>

<!--	This composition is Created when receiving SMS's -->
<Composition type="2" id="1" name="SMS Composition" firstCid="1" priority="0">
  <Criterias>
   <Criteria>
        <Time  id="2" name="Time2" fromTime="20101126 1200" toTime="20101126 1200"/>
```

```
        <Location  id="1" name="Location1" longitude="" latitude="" radius="" activate=""/>
    </Criteria>
    <Criteria>
        <Location  id="2" name="Location2" longitude="" latitude="" radius="" activate=""/>
    </Criteria>
    <Criteria>
        <Time  id="2" name="Time2" fromTime="20101126 1200" toTime="20101126 1200"/>
    </Criteria>
 </Criterias>
 <Component type="4" cid="0" name="Notify Me" nextCid="-1" tickerText="got an SMS" contentTitle="SMS" contentText="CallingNumber sent an SMS"/>
 <Component type="5" cid="5" name="SMS Filter" nextCidIfMatch="0" nextCidIfNoMatch="0" matchType="1" />
</Composition>

<!--    This Composition Criterias when the phone receives a GPS location changed event -->
<Composition  type="3" id="3" name="Location Composition" firstCid="0" priority="0">
  <Criterias>
    <Criteria>
        <Time  id="2" name="Time2" fromTime="20101126 1200" toTime="20101126 1200"/>
        <Location  id="1" name="Location1" longitude="" latitude="" radius="" activate=""/>
    </Criteria>
    <Criteria>
        <Location  id="2" name="Location2" longitude="" latitude="" radius="" activate=""/>
    </Criteria>
    <Criteria>
        <Time  id="2" name="Time2" fromTime="20101126 1200" toTime="20101126 1200"/>
    </Criteria>
  </Criterias>

  <Component type="4" cid="0" name="Notify Me" nextCid="-1" tickerText="got a location update" contentTitle="GPSUpdate" contentText="Got a GPS location Changeg event."/>
 </Composition>
</Compositions>
```

All compositions will be set within the <Compositions> tag. A composition that is created is placed within the <composition> tag. The composition can be any one of the three types Call_Type, Sms_Type and Location_Type. Whereby, the Call_Type compositions are compositions that are triggered by incoming calls. The Location_Type compositions on the other hand are compositions that are triggered by the change in location. Finally the SMS_Type compositions are compositions that are triggered by an incoming SMS. Within the composition different criterias are defined. All criterias are placed within the <criterias> tag. A single criteria on the other hand is defined in the <criteria> tag and defines both a time and or a location, the time defines when the composition should work and the location are the coordinates and radius where a composition should work. The time is defined within the <time> tag which has attributes to define the time, and the location is defined in the <location> tag which has attributes defining the location. Finally the components that make up the composition are defined within the <component> tag. This tag also has attributes to define how the component is to be used and at the same defines how the component communicates with the other components. This XML contains all the entries within the calendar, map and all the compositions created in the composition area.

4.5 Usability in the Easy Composer

One of the main objectives is to ensure that the system is highly usable. In order to meet the usability requirements the usability heuristics by Jakob Nielsen [29], were applied. These principles in addition to the specified usability requirements from the user centric design helped in coming up with a usable system. The usability features in the system include:

1. Easy composer is quite interactive in nature and allows the user to know what is going on at all times. The system reacts when actions are carried out and keep users informed about what is going on. The feedback time is also quite good.

2. Easy Composer matches the users' real world: By incorporating the calendar and the map the user is presented with tools that they are used to. In addition the system incorporates some already existing tools that the user is familiar with. Such as the Google maps.

3. User control and freedom: Users have been placed with the ability to undo errors that they create. For instance when they add new components to the service composition area by mistake they are allowed to delete these components. In addition if they set wrong connectors they are allowed to delete them or reconnect them to a new component. They are not forced to restart the whole composition process.

4. Easy composer interface is very consistent with the use of its language and style of layout and icons. In that the user is presented with buttons with similar names which do more or less the same thing. Example the add button simply means you are adding something regardless of the panel the user is making use of.

5. Error prevention: The current design is also keen on preventing errors by ensuring users follow a proper flow when carrying out the composition process. For instance you cannot attach profiles to locations if the profiles do not exist. Clear error messages are also presented in case of errors.

6. Flexibility and efficiency of use: In that the system offers shortcuts for the experienced users. The user can access his/her profiles on a panel that is at the bottom part of the application and you do not have to go to the composition area in order to open your profiles.

7. The user has also been presented with a very easy tool that allows for easy navigation through the system with a lot of ease. The processes involved are very easy and straight forward for users who are used to graphical user interfaces

5 Scenario Based Assessment

The Scenario based assessment will assess the capability of the software tool developed with respect to performance objectives of the tool that is if it the Composition tool allows for end users to compose value added services from existing services. Also to be assessed is the usability of the tool. Usability is considered here as it is an important aspect in end user service composition as most existing composition tools and techniques are not usable by end users who have no programming or technical skills. The assessment approach in this case is based on two assessment approaches. These are the Performance Assessment of Software Architecture (PASA) approach [30] and the Scenario based Architecture Level UsabiliTy Analysis (SALUTA) [31]. These two techniques are both based on scenarios and the scenarios described in chapter 3 are developed in light of these techniques and will be used in the assessment. The main aim of this assessment is to see if the service composition tool is able to achieve the task of end user service composition.

The approach followed is the IBMs model for designing SOA solutions [32], where each scenario is subjected to several steps in order for the personas in the scenarios can come up with compositions. The process starts by focusing on the goals and objectives that are to be achieved. Next the processes and tasks that have to be carried out in order to achieve these goals and objectives are explored. These objectives will provide the functional requirements that the solution has to meet. The modelled tasks and processes will then be used to help identify services that will be useful in creating a solution that meets the requirements. Service specifications and implementations will then be created that fulfil these requirements. Therefore in each scenario the process will follow the following steps: service identification, service specification, service realization, service composition and service implementation. While this process is being followed a more detailed discussion of the composition tool on its use is carried out and the specific features that support the scenarios are mentioned.

In addition the results are explored pointing out the problems found in more depth giving alternatives or recommendations for meeting performance as well as Usability objectives. An analysis is finally carried out to determine whether the tool will support the general objectives of end user service composition.

5.1 Parental Control Scenario

In this section a parental control service is created. It is based on the scenario where Jane creates a service for her daughter Sophie. This service is meant to control the usage of the daughter's phone and at the same time track movement of the daughter. In order for Jane to come up with the service she has to identify the particular services that should be connected in order to meet the need. The starting point is by capturing the goals and objectives that should be met by the service. This will help her identify and specify the service that she needs to create. Finally Jane composes the service by combining the components identified in the service composition tool.

5.1.1 Goals and objectives:

In the definition of the scenario Jane had identified the following objectives:

- Jane wants to know where Sophie is and therefore needs to track her movements. She sets various locations that Sophie should be at all times and get alerts when Sophie is at these locations. In the case when she is outside of the safe radius she gets alerts as well.
- Jane also wants to be able to control when the daughter uses her phone and how she uses it by specifying the times when and where she should use it and what features she can use.
- Jane intends to set filters for what content her daughter views on her phone. She should not be able to view inappropriate materials.

5.1.2 Service identification and specification:

From the Objectives Jane requires the following services in order to compose the service required:

1. A service that allows for user location tracking, this will allow Jane to get her daughters location updates as she moves from one location to the other.

2. A mapping service that allows Jane to specify Sophie's locations. This utility includes the locations that Jane needs to be notified about when Sophie is in motion as well as locations when the phone's context should change. It will also be used to show the location of Sophie.

3. A service that will send out alerts is required to send the messages to Jane when the daughter leaves or enters the targeted locations

4. A filtering service is required. This will filter the caller numbers that Jane does not want contacting the daughter's phone. Jane will specify the numbers that she intends to be able to contact Sophie.

5. A scheduling service that will allow for Jane to set the times when the phones context should change. In concept this should work similar to the mapping service in that the time will trigger a change in a feature of the phone.

6. A service that controls the settings of the phone. This service will help Jane to set when certain features of the phone are to be used. For instance she can specify when the mobile data can be turned off.

7. A parental control service is also required to ensure that Sophie does not access inappropriate material.

In this case Jane will be able to get updates when Sophie enters or leaves the set locations at the same time control how and when Sophie uses her phone and what content she can access.

5.1.3 Service Components for Realization

The next step is to determine how the services identified can be realized. In this case Jane identifies the service components that will be able to achieve her objectives. Each of these components provides services and capabilities according to the service specification.

The following components are identified:

1. Map component: The mapping service will allow for searching of addresses and set locations that Jane intends to set for her daughter. Jane will also be able to see these locations on the map and also the location of her daughter.

2. Location component: This component will allow for Jane to specify the radius of the location as well as the contexts the phone will have on the locations. The location tracking works based on this information.

3. SendSMS component: this component allows for a set message to be sent from one party to another when triggered. In this case the sendSMS component will allow for Jane to get messages on the daughter's location.

4. Calendar component: This service allows for entry of tasks that the user wants to do at particular times. It can also be attached with a phone context that is activated at the specified time. In this case Jane will set what times the daughter's phone should and should not be used.

5. V.I.P list component: This is a filter component that allows for the phone to receive calls only from certain numbers while others will be forwarded or disconnected. In this case Jane can specify which numbers can be able to call her daughter.

6. Parental Control component: this component allows for inappropriate content not to be viewed on the phone. Thereby Jane can specify what content cannot be viewed by Sophie.

5.1.4 Service Implementation

The final step is to assemble the service components identified to use their capabilities in the creation of a new service composition. Using the Easy composer, Jane will compose a parental control service for her daughter. The first step will be to go into the composition area and compose the services. On composing these services they will be saved as profiles. Then Jane will go into the map area and create the locations the daughter will be operating in. When these locations are created, Jane will attach the required profiles. In the following step, Jane enters the times when the daughter should not use the phone in the calendar and attaches the profiles to be activated at the times when the service is meant to work. Finally the Jane exports an xml that is deployed to her daughter's android phone that will be running the Easy Droid. These service profiles will be activated according to the times scheduled in the calendar and locations specified in the map area.

5.1.4.1 Service Profiles Creation:

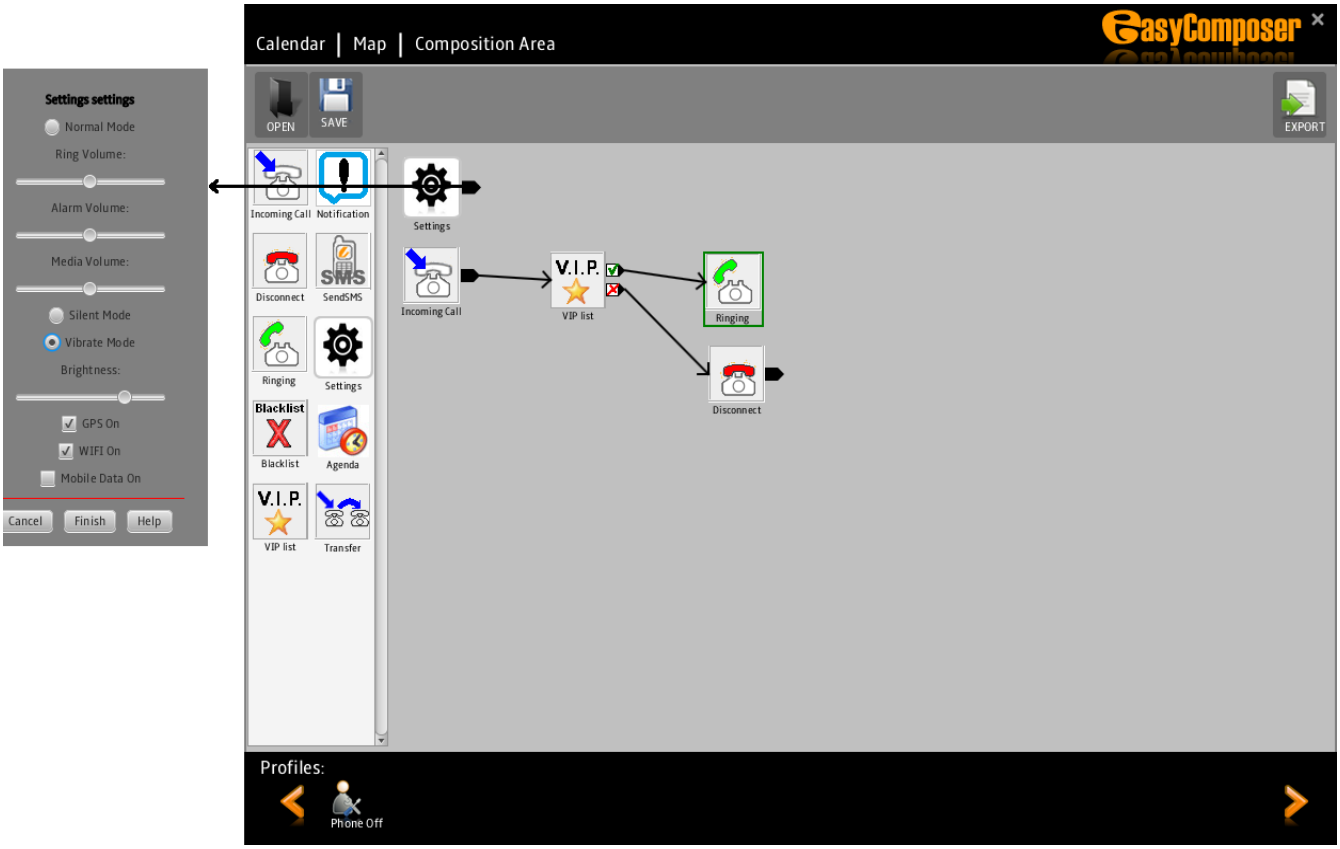

Figure 5-1 Parental control service composition: Phone off profile

From the Figure 5-1 above Jane creates a profile that will ensure that Sophie's phone has certain settings active, that is internet connection is disabled and at the same time the incoming calls are disconnected. In addition there is a V.I.Plist filter component that only ensures certain numbers to be able to call Sophie's number. Having created this composition Jane saves it and gives it a name Phone Off.

Figure 5-2 Parental control service composition: Alert Me profile

Jane creates an alert profile as shown in Figure 5-2 that allows for her to get messages when her daughter moves from one location to another. She uses the SendSMS component that she can specify the number and message to be sent. When she is done she saves the profile as Alert Me. Having created the profiles she needs, she has to attach the service profiles to a context.

5.1.4.2 Location Based Compositions:

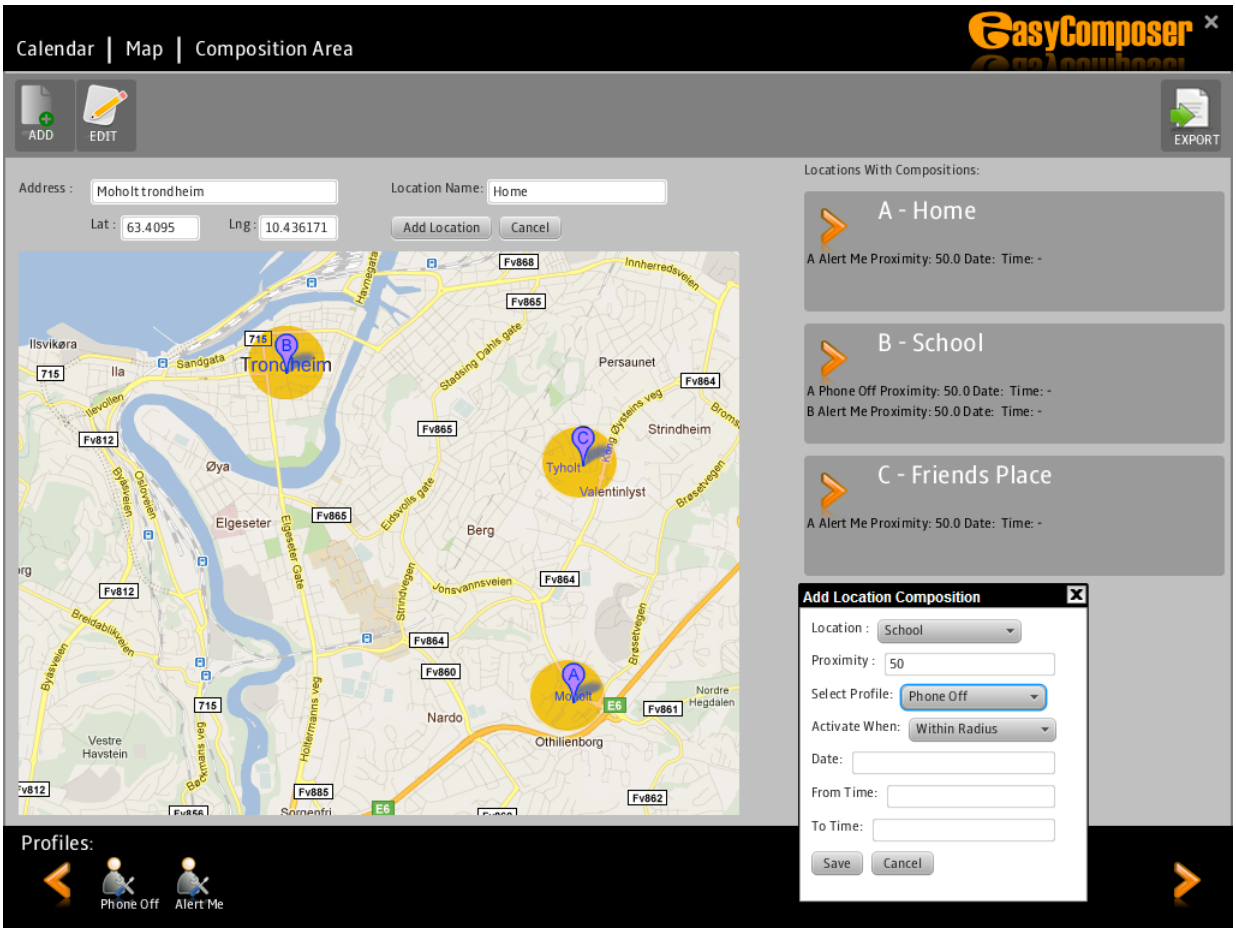

Figure 5-3 Parental control location based compositions

Jane begins working on the location compositions by first creating the locations for Sophie. Having added all the locations required she will then attach the service profiles she created in the earlier step. As shown in Figure 5-3, Jane does this by setting the radius and how the profile is to be triggered. In addition she can set the times she wants these profiles to be activated. Therefore Jane will be able to get alerts when her daughter enters or leaves a location.

In addition Jane will set that in the school location the phone should not be functioning so as not to cause disruptions in class, therefore Jane attaches the Phone Off service profile to this location.

5.1.4.3 Time Based Compositions:

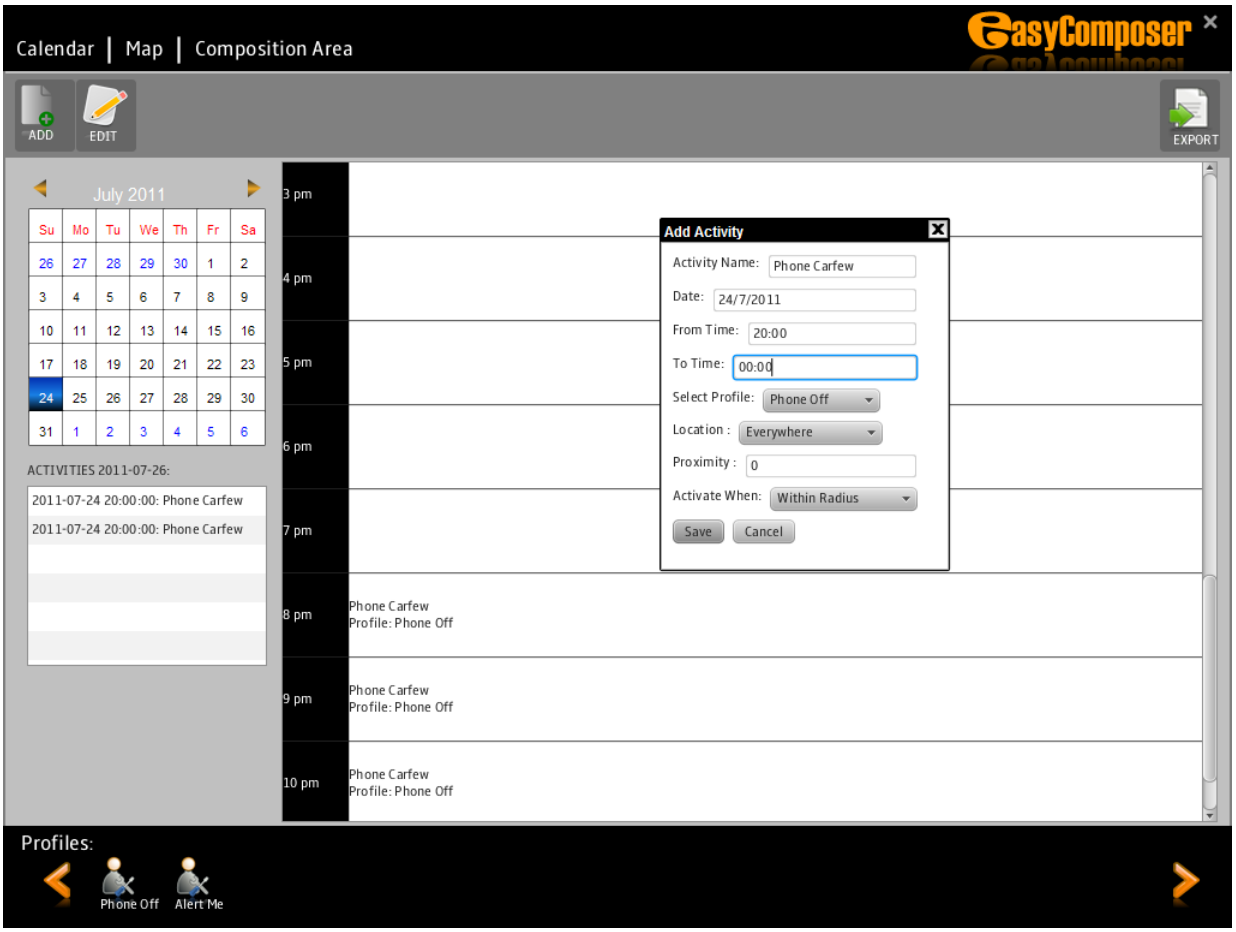

Figure 5-4 Parental control time based compositions

Once Jane has created the location compositions, she switches to the calendar area where she sets the curfew for her daughter. In this case she would like to set that in the evenings Sophie does not use the phone after eight o'clock in the night. As shown on Figure 5-4 Jane logs this information in the calendar at the same time setting the phone off profile to allow for the curfew to work at this time.

5.1.5 Exporting the XML

The final step is whereby Jane exports the XML which will be uploaded to an online server. This will allow Sophie's phone installed with Easy Droid to download the XML with the compositions uploaded. The XML exported can be view in the appendix B1 section. Once exported, the Easy Droid will have an output as shown on Figure 5-5 and will automatically configure the phone to behave in certain ways at the specified locations and times.

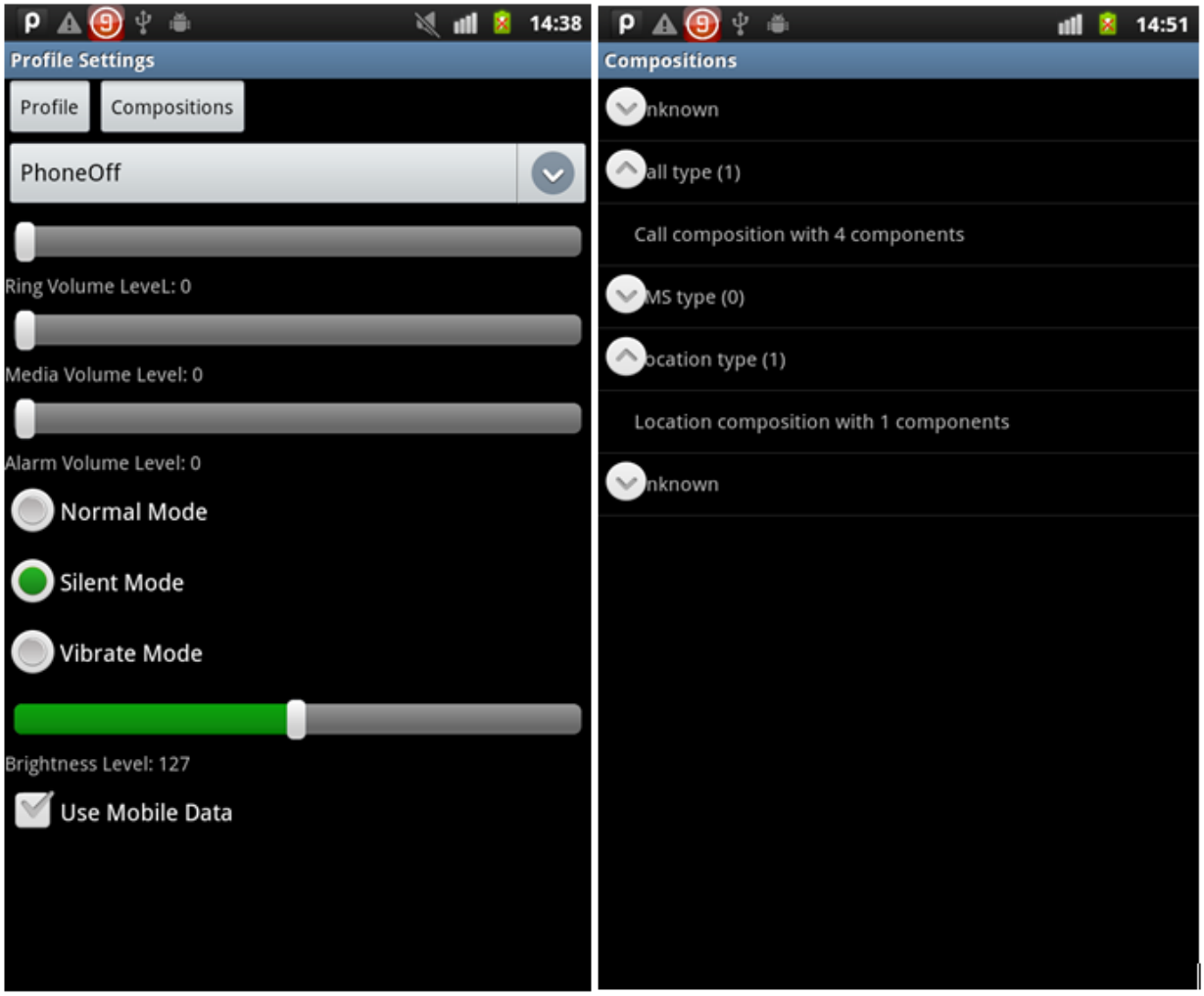

Figure 5-5 Parental Control Scenario Easy Droid Output

5.2 Doctor's appointment Scenario

Esther has been sick and has appointments with the doctor who follows up on her health condition. Due to her old age a problem presents itself whereby Esther forgets most of her appointments. In addition she has gotten lost several times while going to the doctor. Since Jane is quite unavailable a service is required to make sure the mother gets to her appointments. Once more Jane is faced with task of creating a service that will help her get to her appointments on time and getting back home by herself without getting lost. She will first identify the services required and then compose the services using the service composition tool.

5.2.1 Goals and Objectives

In the light of this problem the following are the goals and objectives that Jane wants to achieve when composing a service for her mother, Esther:

- Jane would like to set reminders for her mother, to remind her of her appointments with the doctor in good time so her mother can prepare and make it in good time. Additional reminders are required to inform her when she should leave the house. In addition Jane would like to get similar reminders in order to call her mother in order to remind her of the appointment and checking on her condition to see if she is fit to make the trip on her own. If not she will have enough time to arrange for her to get to the appointment on time.
- In addition Jane would like to track Esther's movement to ensure that she does not deviate from the set route to the doctor's. She will therefore ensure that she does not get lost.

5.2.2 Service Identification and specification:

In mind of the objectives that Jane wishes to accomplish, she intends to create a service that will help her mother get to her appointments. In order for her to create the service she has to first identify and specify the required services for this. The services required include the following:

1. A service that allows for user location tracking, this will allow Jane to get her mother's location updates as she moves from one location to the other.

2. A mapping service that allows Jane to specify the route which the mother will take to the doctor. This will be a schedule of locations that the mother will pass through on the way to the doctor and back home.

3. A messaging service is required to send messages to both Jane and the mother to act as alerts that inform them both about the appointment. The messaging service will also be used to inform Jane when the mother has deviated from the set course.

4. A calendar service that will allow for Jane to set the mothers appointment. The calendar will contain all the appointments and what should happen at these particular times.

5. A bus route information service that will give information about bus timings and when Esther should go to the bus stop to catch a bus in order to arrive to the appointment on time.

If a service is composed using the above mentioned services then they can ensure that Esther gets to her appointments with minimal intervention from Jane and at the same time ensuring that Esther is monitored.

5.2.3 Service Components for Realization

Having identified the services, Jane has to determine how the service to be composed can be realized. Here she will identify the service components that will be able to achieve this. Each of these components provides services and capabilities according to the service specifications. The following components are identified:

1. Map Component: The mapping service will allow for searching of addresses and for her to set locations that Jane intends to locate her Mother with. Jane will also be able to see these locations on the map and also to locate her mother's movement on the map.

2. Location component: This component will allow for Jane to specify the radius of the location as well as the events to occur at these locations. The location tracking system will use this information.

3. SendSMS component: this component will allow both Jane and the mother to get reminders of appointments in form of SMS's. In case the mother deviates from the set route this component will also send a message to Jane.

4. Calendar Component: This service will allow for Jane to enter all her mother's appointments and in addition attach alerts for both herself and the mother.

5. Bus route schedule component: That will give Esther bus information. This is will alert Esther where and when she should take the bus.

5.2.4 Service Implementation

Here Jane will once again compose a service for her mother using the Easy Composer. In this case she will be using the components that she identified to compose the service. Jane begins by creating the service profiles and then setting the time based compositions and finally sets the location based compositions. The service profiles she creates are majorly alerts and reminders that are required to remind the mother what to do and which allow Jane to monitor her mother. In order to specify the time based compositions Jane will log on to the calendar enter the mother's appointments and set the service profiles that should work at these times. Finally in the map, Jane will set the location based compositions by specifying the locations and the compositions that should work in this case.

5.2.4.1 Service Profiles creation:

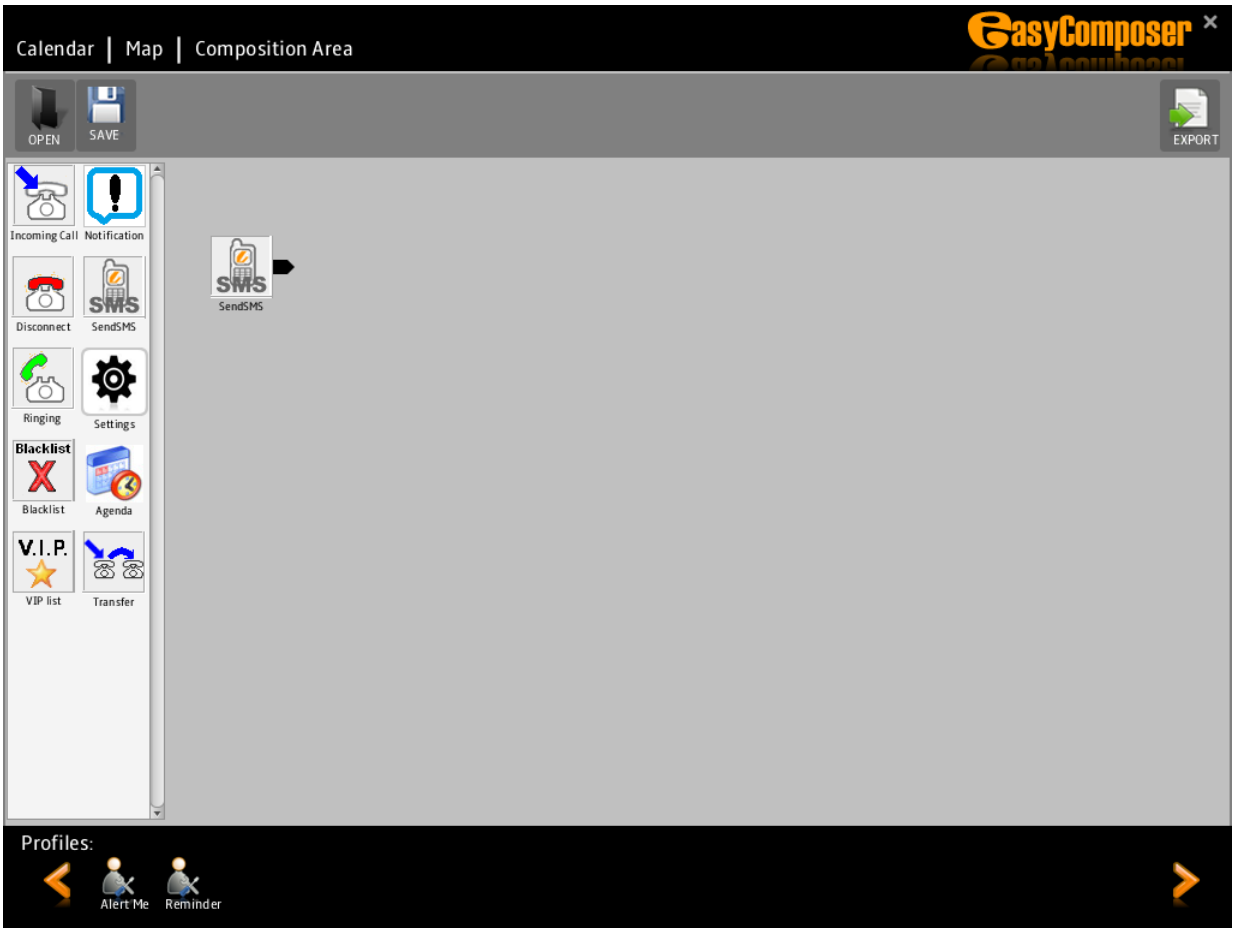

Figure 5-6 Doctor's Appointment scenario service composition

Jane logs into the composition area and creates two service profiles as shown in Figure 5-6. Both use the SendSMS component. The Reminder profile will send out SMS messages to both Esther and Jane to remind them of the appointments while the Alert Me is an SMS message to Jane to alert her about her mother's movement.

5.2.4.2 Time Based Compositions:

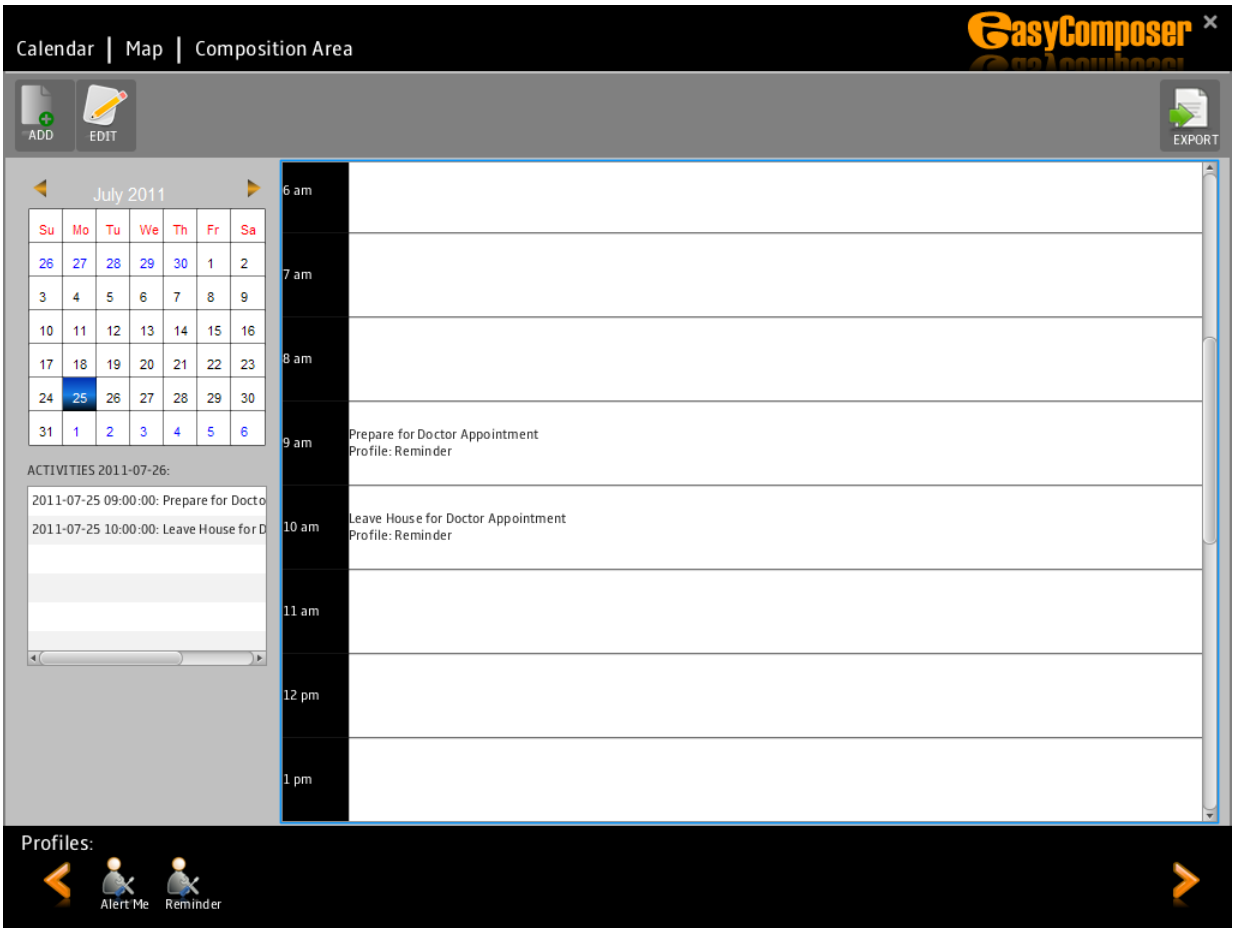

Figure 5-7 Doctor's Appointment time based compositions

Jane sets the mother's appointments in the calendar as shown in Figure 5-7. She does this by setting the time when the mother should start preparing herself for the appointment; this is one hour before she leaves the house. She then sets the time that the mother should leave the house. These tasks have a reminder profile attached to them which will be setting reminders for both Jane and her mother. When these times are reached the messages are sent to both of them.

5.2.4.3 Location Based Compositions:

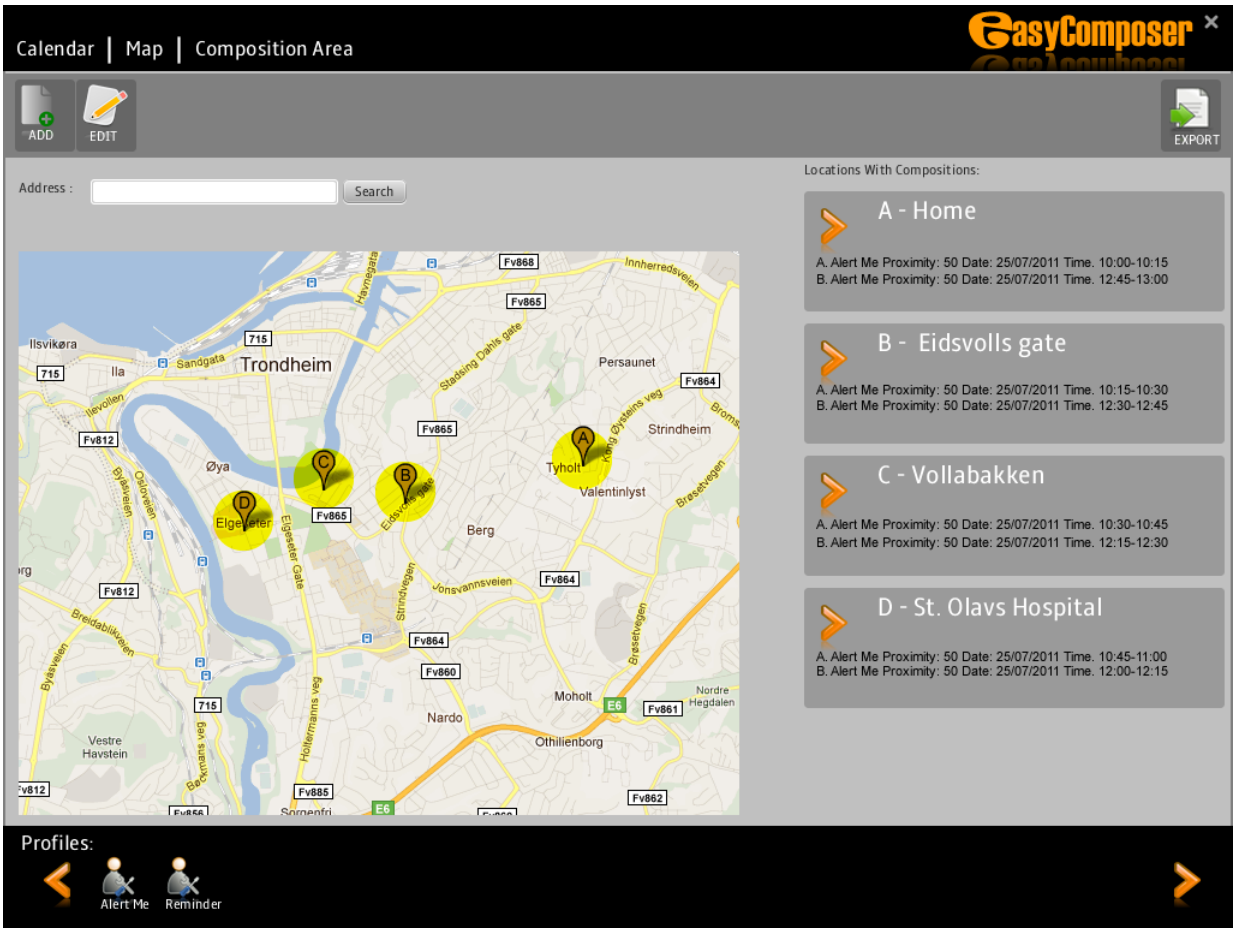

Figure 5-8 Parental control location based compositions

Finally Jane has to create a service that will help her monitor the mother on the map panel as shown on Figure 5-8. Therefore she defines points on the way from home to the hospital. She specifies the radius to these points. Jane then sets the Alert Me profile to these points at certain time intervals when the mother is expected to be at these points. These alerts are sent to Jane if the mother is within the radius or not. If the mother is not within the radius of these points at these times, Jane can call to confirm with the mother if she is deviates from the route on her way to the hospital or going back home.

5.2.5 Exporting the XML

The final step is to export the XML which will be uploaded to an online server. This will allow Esther's phone installed with the Easy Droid to download the XML with the composition created. The XML exported can be viewed in the appendix B2 section. This basically specifies the locations to be used to monitor Esther's movement as well as the times when reminders should be sent to the mother. The output on the Easy Droid is shown in Figure 5-9.

Figure 5-9 Doctor's Appointment Scenario Easy Droid Output

5.3 Home Delivery Scenario

In this scenario Dan is faced with the task of creating a service that will allow for him to plan for deliveries. This service is meant to make his work and that of his colleagues much easier. In order for the service that he intends to create to be successful it should allow for him to ensure that deliveries are made on time and correctly. Dan has to identify the services that he requires to compose his delivery planning service. Then he will map these services to the components present in the service composition tool. Finally Dan will compose the service. Having composed the service, Dan assesses the created service to see if it meets his set objectives.

5.3.1 Goals and Objectives:

In order for the delivery service to be successful it has to meet the following goals and objectives:

1. The service should allow for proper planning of deliveries. In this case the deliveries should be assigned to the right persons and in the right way to avoid over booking delivery persons schedules or making double bookings.

2. It should also allow Dan to sort deliveries based on delivery regions and locations. Dan should have the ability to define customizable delivery regions, where different delivery persons will be based. In addition Dan should be able to see the delivery persons' locations in order to select the delivery persons closest to the delivery address to make the deliveries. The service should also give the delivery persons the fastest routes to the addresses specified.

3. Also a description of the goods to be delivered should be clearly presented to the delivery person to avoid mistakes. The service should also allow delivery persons to view their scheduled deliveries when the need arises.

5.3.2 Service identification and specification:

From the defined goals and objectives above the services that will be required to compose the delivery service include the following:

1. A mapping service that allows Dan to specify the different delivery regions as well as the locations where deliveries have to be made. This will make it easier for the delivery persons to also identify the delivery addresses.

2. A service that allows for user location tracking, this will allow Dan to track where his delivery persons are at all times. Therefore he can be able to assign them regions with regards to the amount of deliveries to be made at one particular time. This tracking will also allow him to know when deliveries are running late.

3. A messaging service is required to send messages. Numerous amounts of messages will be sent to ensure coordination when deliveries are being made. Messages will be sent to customers to confirm their availability. Messages will also be sent to delivery persons as reminders for deliveries and also Dan will receive messages when there are delays in deliveries.

4. A calendar service that will allow for Dan to enter the orders for the delivery persons. These entries will contain the information of the orders. The delivery persons can also view the orders that they need to deliver.

5. Traffic information services that will give information about the city's traffic to enable the delivery person manoeuvre through the city in ease. Dan can also use this facility when planning for who should handle the deliveries as he is able to see the traffic conditions on the ground.

Having identified the services that he needs, Dan can have a clear picture of what he needs in order to compose the right delivery service that will make the delivery process quite easy.

5.3.3 Service Components for Realization

Dan will analyse the tool in this step to identify the components available to allow him compose the required service. In this case the following components are identified:

1. Map Component: This component will be quite helpful for Dan and the delivery persons as it will allow them identify addresses where the deliveries are to be made. In addition Dan will need this service to define the regions that he requires and also view the locations of his delivery persons.

2. Location component: This component will be used to define the locations and attributes of these locations. These are the triggers within the locations as well as the radius that this locations cover. This component will be closely integrated with the map service and the location tracking will get information from this component.

3. SendSMS component: This component will enable Dan to send the different messages that are required.

4. Calendar Component: In this service Dan will enter the orders for the different delivery persons. This will also be used by the delivery persons to view the orders that they need to deliver.

5. Traffic Information Component: That will give traffic information. This will help finding the fastest routes to the desired destinations. The delivery persons will greatly benefit from this service.

5.3.4 Service Implementation

In this step Dan creates a composition using the components that he identified. First Dan will log into the system and create profiles. These profiles are also messaging profiles that will give out the different alerts and reminders required in order to run the delivery operations. When customers call in and place orders, Dan first enters the location of the customer into the delivery person's map. Having entered the address he will then add the order information into the delivery person's calendar and attach a reminder profile, which will remind the delivery profiles to begin the delivery. In addition a confirmation message will be sent to the customer to confirm if he or she is at home, before the delivery person prepares to make this delivery.

If the customer is not available he will contact the delivery person and they can agree on another desirable time. In addition Dan will enter the time when the delivery is to be made in the calendar. This time on the calendar will be combined with a location, which is the address that was earlier entered as a location in the system. This will allow for an alert to be sent out to Dan if the delivery person does not reach this location at the time specified. Having done this then Dan will export the XML's.

5.3.4.1 Service Profile Creation:

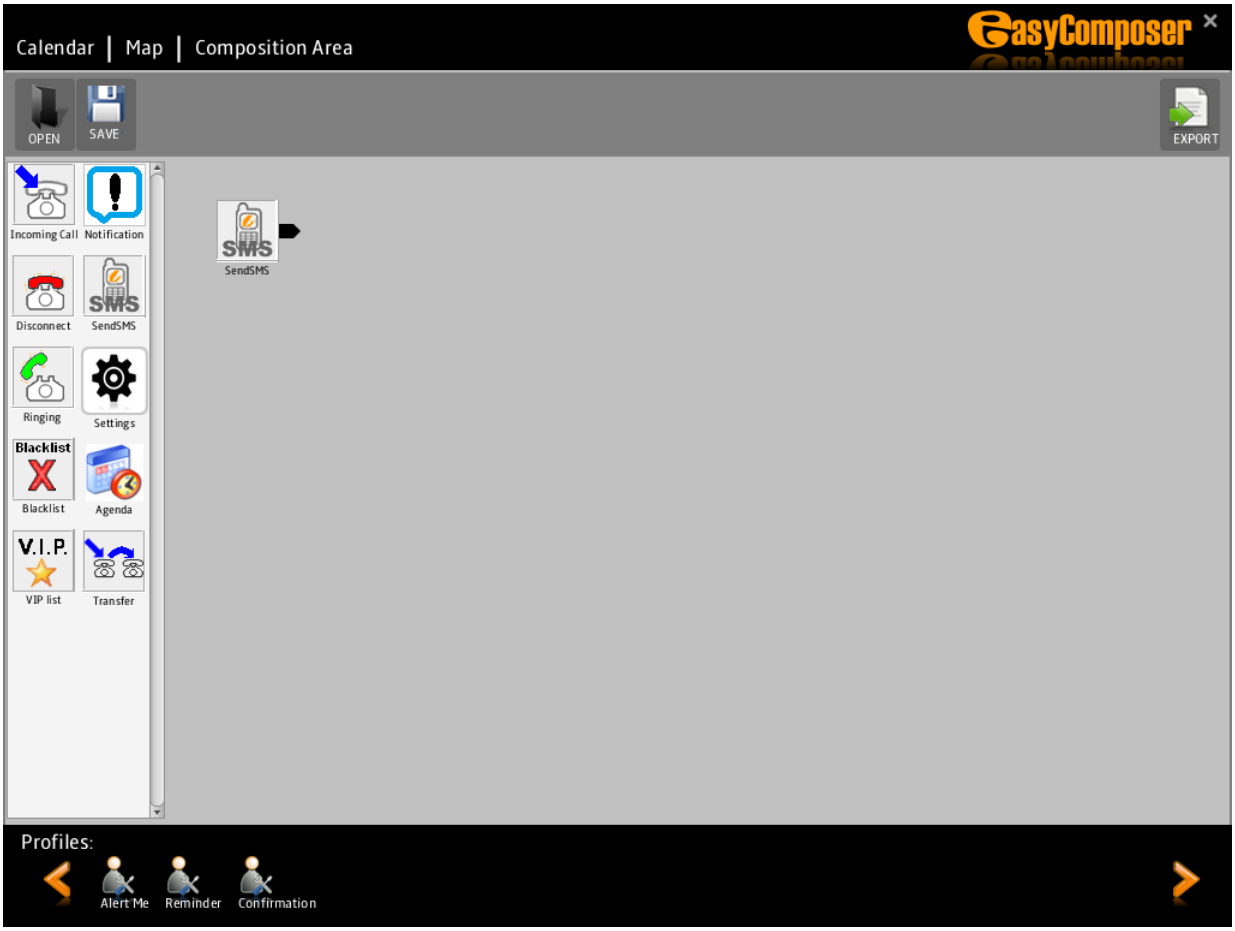

Figure 5-10 Home delivery scenario service composition

From the Figure 5-10, the profiles that Dan will create for the different delivery persons are shown. These delivery persons can create more services for their own use but these are the main profiles required for the delivery service.

The confirmation service profile will allow for confirmation messages to be sent to the customers. Reminder service profile on the other hand will allow for delivery persons to get reminders about the deliveries. The final service profile is the alert me profile which alerts Dan with a message about deliveries being late.

5.3.4.2 Location Based Compositions

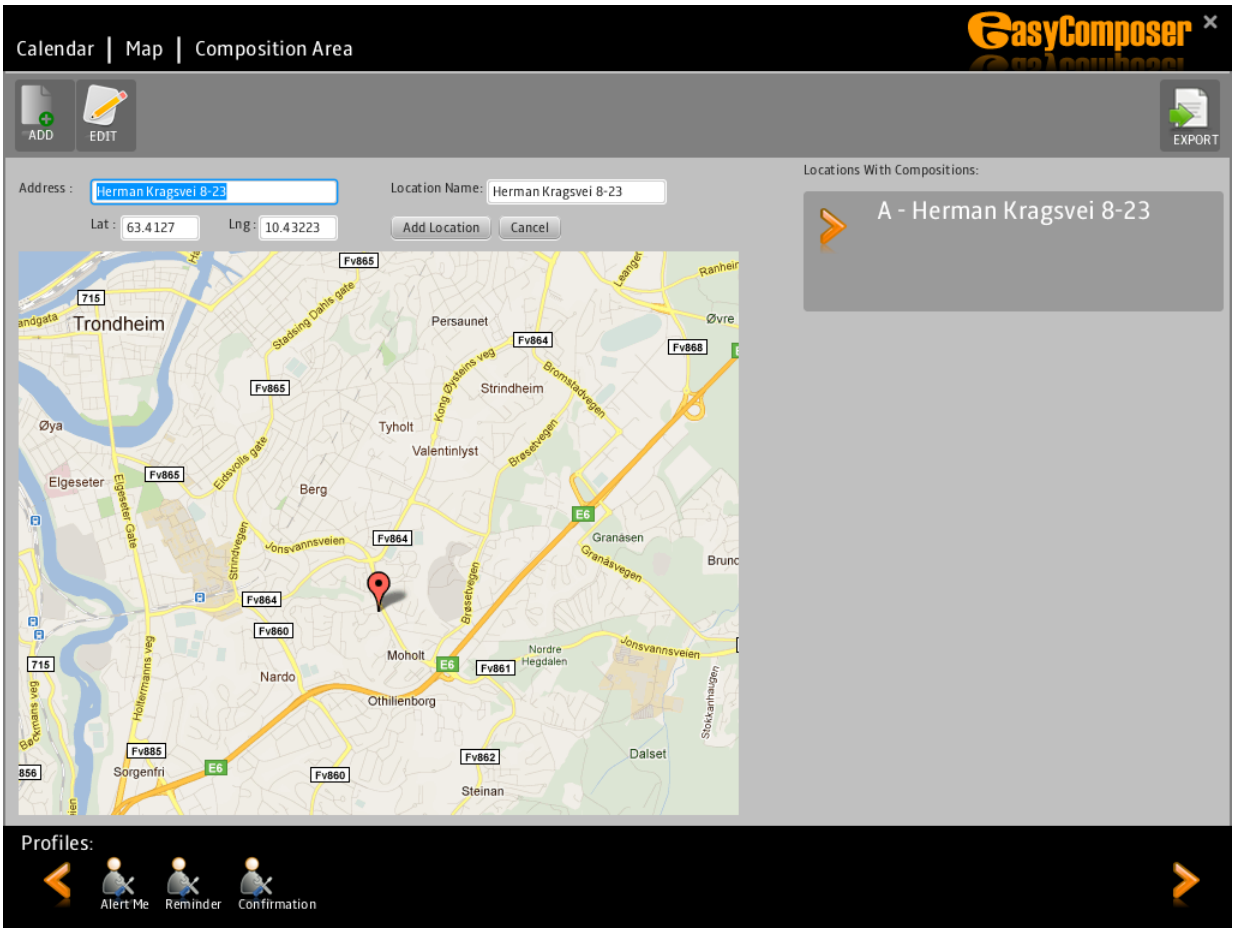

Figure 5-11 Home delivery scenario Location composition

When Dan gets an order he will begin by entering the address information in the map area. He then saves this location by address name. From Figure 5-11, a customer's order is to be made to Herman Kragsvei 8-23 therefore Dan saves this location into the delivery person's locations.

5.3.4.3 Time based compositions:

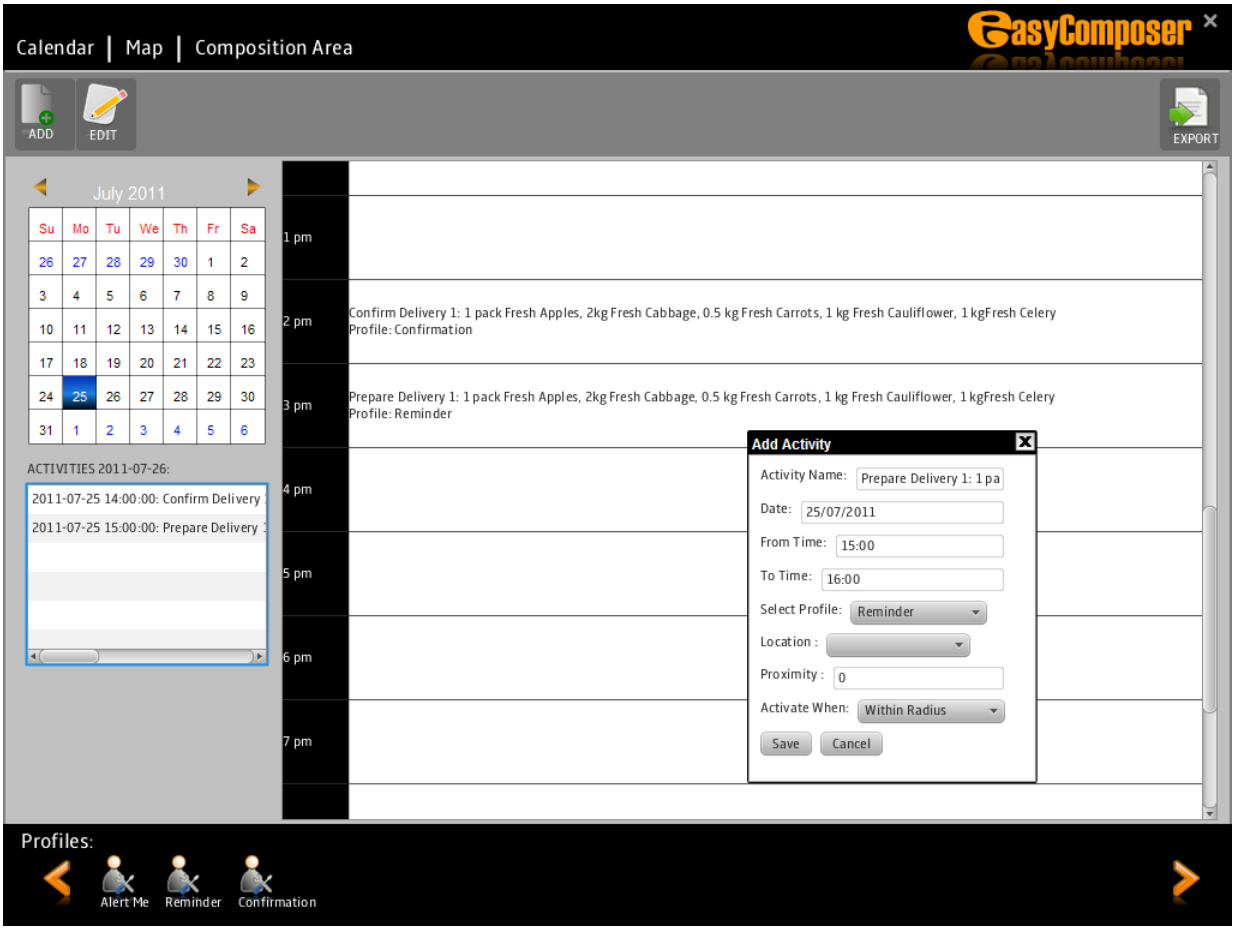

Figure 5-12 Home delivery scenario confirmation and reminder

Having made the location for the order Dan will log in to the system and create a task that first sends out a confirmation to the customer asking if the delivery should still be made. This is done in advance before the delivery person starts to prepare for the delivery. The confirmation message in this case will be sent automatically. A reminder message will be sent in good time so that the delivery person can call Dan in the case his/her delivery schedule is running late. This will give Dan enough time to make any changes necessary. Figure 5-12 shows how Dan enters this information in the calendar.

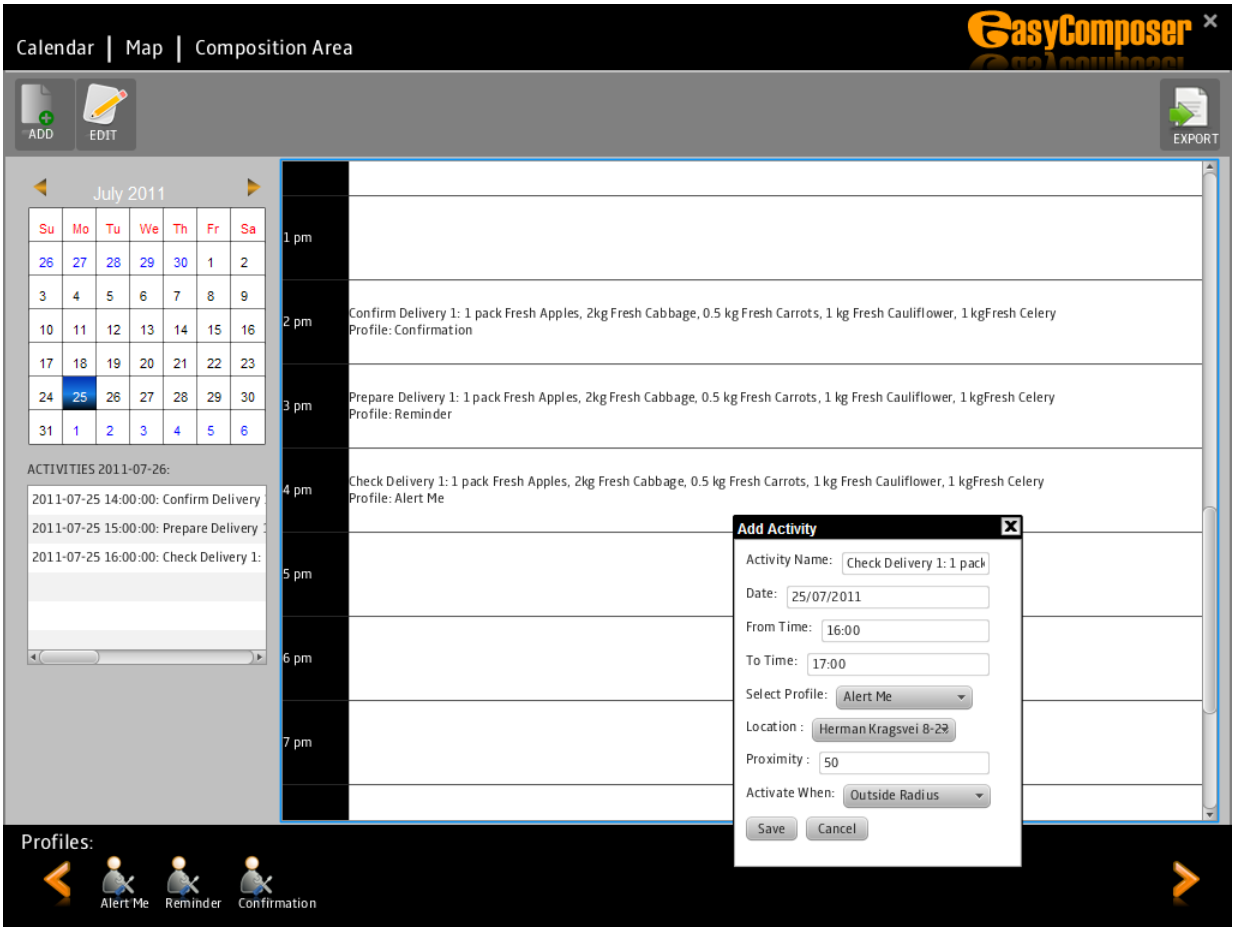

Figure 5-13 Home delivery scenario delivery check

In addition Dan will add a location check on the calendar as shown on Figure 5-13 to make sure that the delivery person is within this area at the specified time. If the user is outside this radius an alert is sent to Dan every time a location check is carried out.

5.3.5 Exporting the XML

Dan will carry out this step for all the orders. In order for the delivery persons to get this information Dan will have to export this information in form of XML. The delivery persons' android phones running the Easy Droid will download this XML. This therefore ensures that the delivery processes are carried out automatically and delivery persons can also log into their systems and get different information about orders and delivery. The XML exported can be viewed in the appendix B3 section. After exporting the xml, the output on the Easy Droid will be as shown on Figure 5-14.

Figure 5-14 Home Delivery Scenario Easy Droid Output

5.4 Busy Student Scenario

Ian creates a service to help him in planning his studies. Ian would like to take advantage of the mobile phone as a personal management tool. In this case Ian will create a service that will help him manage and plan his daily student related activities as well as his studies. Ian will take a step by step approach to compose a service that will help him manage his assignments and lectures while avoiding disruptions in class. In this case Ian will review his goals and objectives and then specify the services that he will require to compose the service. Having specified the service he will identify the components that he will require from the tool and finally compose the service using these components.

5.4.1 Goals and objectives:

In this scenario the goal is to ensure that Ian plans his time wisely. In this case the tool he wishes to use for this purpose is his mobile phone. The goals and objectives that he wishes to achieve include:

1. Ian would like to avoid causing disruptions while in school. This could be in his classes, while in the study areas as well as other areas where the ringing of the phone would be undesirable. This will ensure that he concentrates on his studies.

2. In addition he would like to be able to manage his time wisely. The tool should help him plan for his classes and help him meet his deadlines on time. He would also like to be reminded of certain activities that he should carry out that are related to his studies.

5.4.2 Service identification and specification

Having reviewed his goals and objectives Ian identifies the services that he requires to compose. In this case the identified services include the following:

- A calendar service that allows for the Scheduling information about the lectures and tasks to be stored and will be able to answer the question whether the student is in a lecture or not.

- An agenda service that will allow for the calls to be disconnected when the student is in a lecture by checking the student's calendar. When there is an incoming call a check is made to see if the student is in a lecture if so then the call is disconnected.
- In order for the students to be notified of the different due dates and locations entered a reminder service is also required. This service will set off a reminder when the specified time is reached.
- Settings service will play the role of defining which settings need to be activated at a particular instance, for instance when in a lecture the volume should be at level 1. Also if the reminders are to go off the appropriate settings should be applied.
- A messaging service will come in handy when sending rejection text messages when Ian is in lectures to inform the caller that he is not available at the moment.
- A service that allows for user location tracking, this will allow Ian get alerts when he reaches a location where a reminder has been set.

5.4.3 Service Components for Realization

In order to realize the services identified above Ian should determine which components to use. He identifies the service components that will be able to achieve the need. These components are identified from the service composition tool. The following components are identified:

1. A calendar component: this component will allow Ian to enter his lecture schedule. This will also be used to log any other information Ian needs to be reminded of. This will also act as the agenda service that Ian identified in the previous section, whereby in that particular time a profile is set that makes Ian unavailable.
2. Settings component: This component keeps track of all the settings at any particular time. In our scenario this will play a big role in ensuring that the appropriate settings are activated whenever the student is in a lecture.

3. SendSMS component: this component allows for a set message to be sent from one party to another when triggered. In this case the sendSMS component can allow for the student to send text messages to his/her callers when he is not available, that is when in a lecture. In this case the SendSMS component will be used to send alerts to Ian.

4. Map Component: This component will help search for and get the coordinates as well as view the locations that have been selected at any one time.

5. Location component: This component helps in location tracking as it defines the locations and attributes of these locations which include the triggers within the locations as well as the radius that this locations cover. It will then give information that the location tracking will use.

Having identified the components Ian can now compose his service. He will now log into the service composition tool and begin the composition process.

5.4.4 Service Implementation

In this case Ian will use the composer and compose a service that will help him in his studies. Having identified the components required he will log in to the system to get access to these components. Ian will begin by designing the profiles that are required in creating the service. The first profile is the InLecture profile. He will also define the reminder service profile. In addition Ian will enter his lecture schedule in the calendar and define what profile should be active when he is in a lecture. He will also enter his deadlines and reminders to that effect. Finally Ian will create his locations and define what should happen in these locations.

5.4.4.1 Service Profiles Creation:

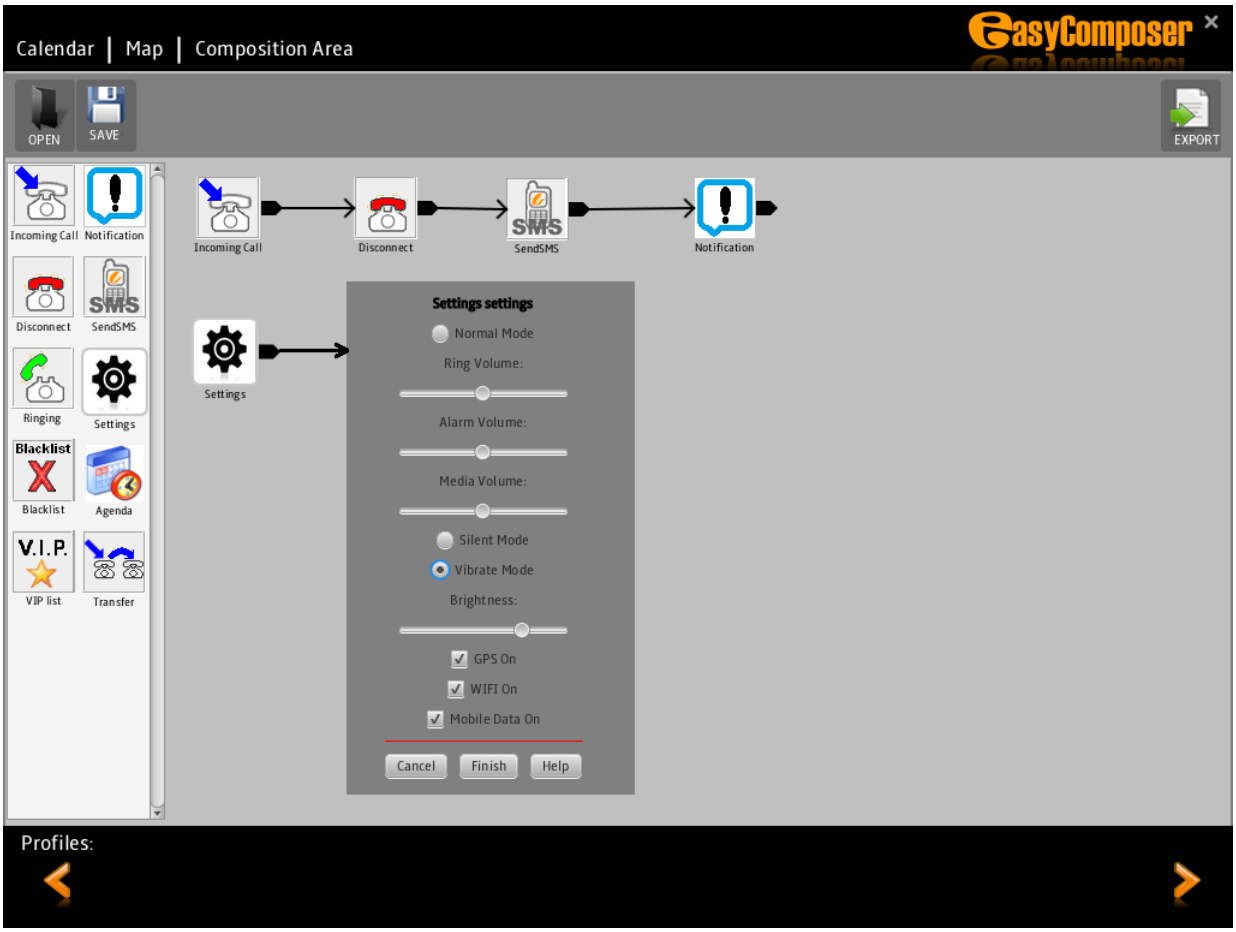

Figure 5-15 Busy student scenario In Lecture Profile

Figure 5-15 shows the composition of a service profile that allows for Ian's phone to be unreachable when he is in class. In this case if someone calls they are disconnected and a message is sent to the caller. In addition a notification is shown to Ian informing him of the call that was disconnected. The phone is also going to have pre-set settings that will make sure his phone does not ring. It will vibrate in case of a reminder and therefore will not cause disruptions in class.

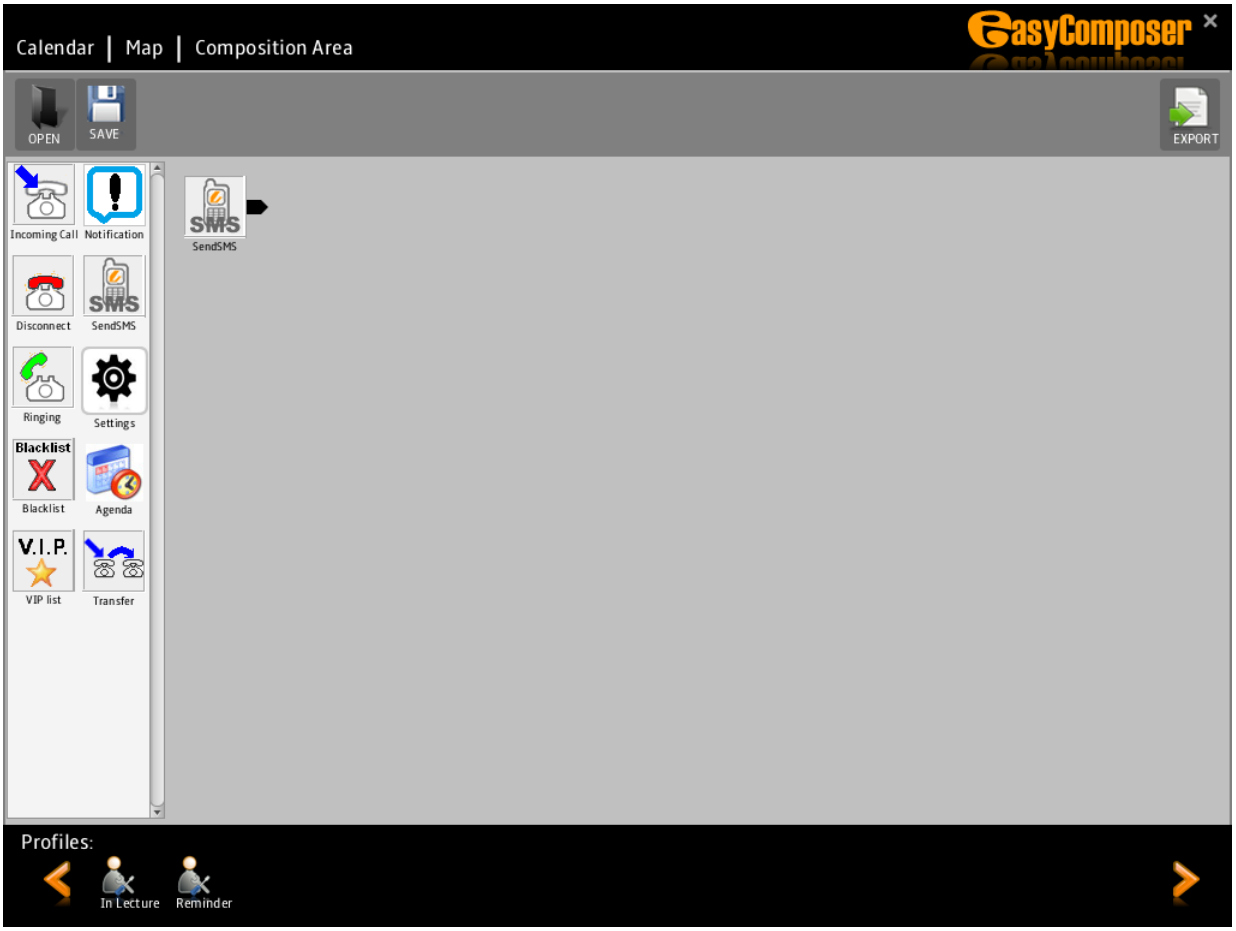

Figure 5-16 Busy student scenario Reminder Profile

Ian will also create a reminder profile as shown on Figure 5-16 that will allow for reminders to be sent to him in form of messages. This profile can be used at scheduled times or locations specified by Ian.

5.4.4.2 Time Based Compositions:

In order to allow the phone to react to the different contexts, Ian will attach the service profiles to the activities to be scheduled. Ian will go about this by entering in the calendar the lecture schedule and in addition selects the profile that will be suitable for the lectures as shown in Figure 5-17. The service profile composed is named as InLecture so when Ian is adding the self-adaptive systems lecture he will also attach the InLecture profile to it.

This will allow the student to attach the contextual information that allows the system to react in the defined way when the lecture time is reached.

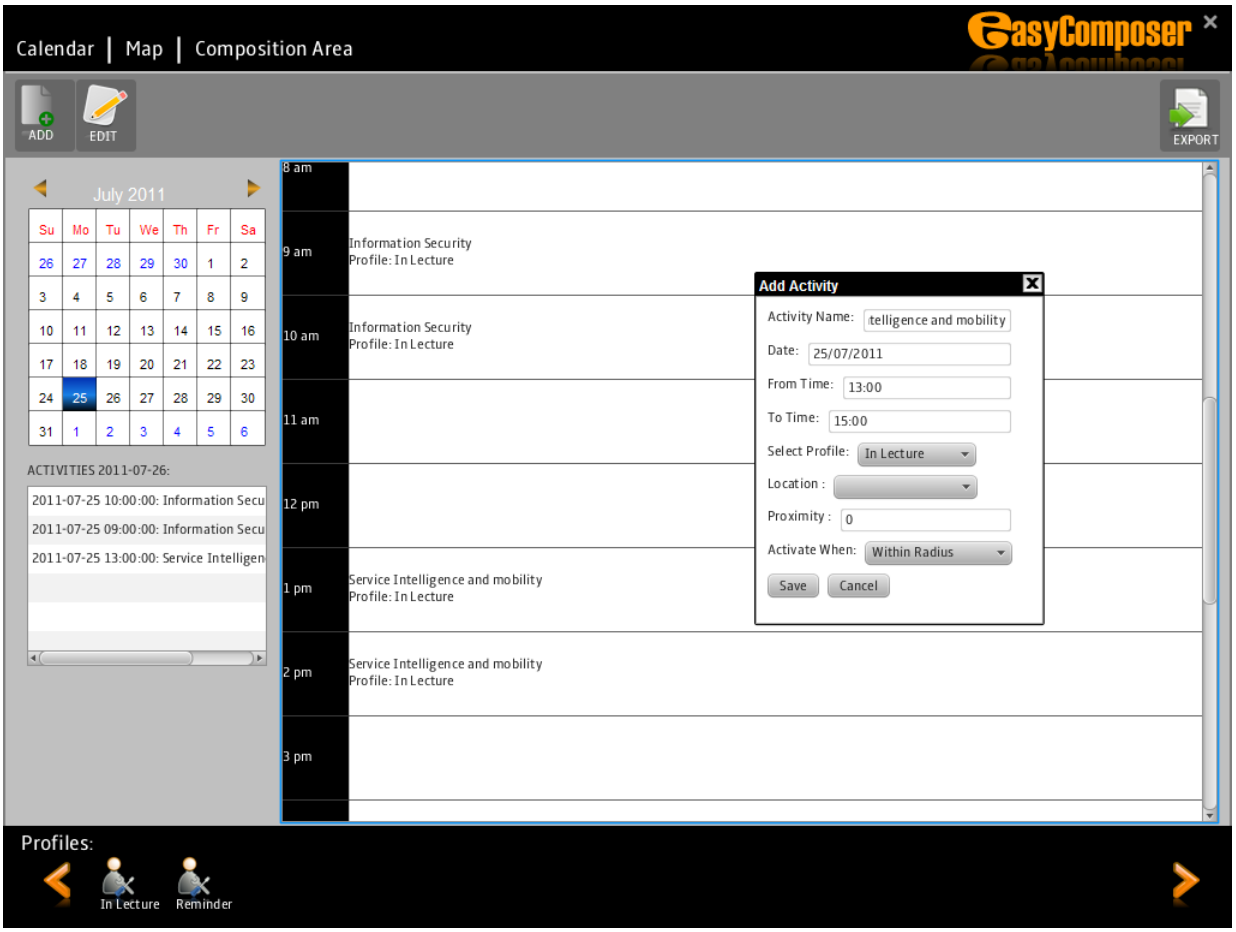

Figure 5-17 View of the calendar with the scheduled lectures.

5.4.4.3 Location Based compositions

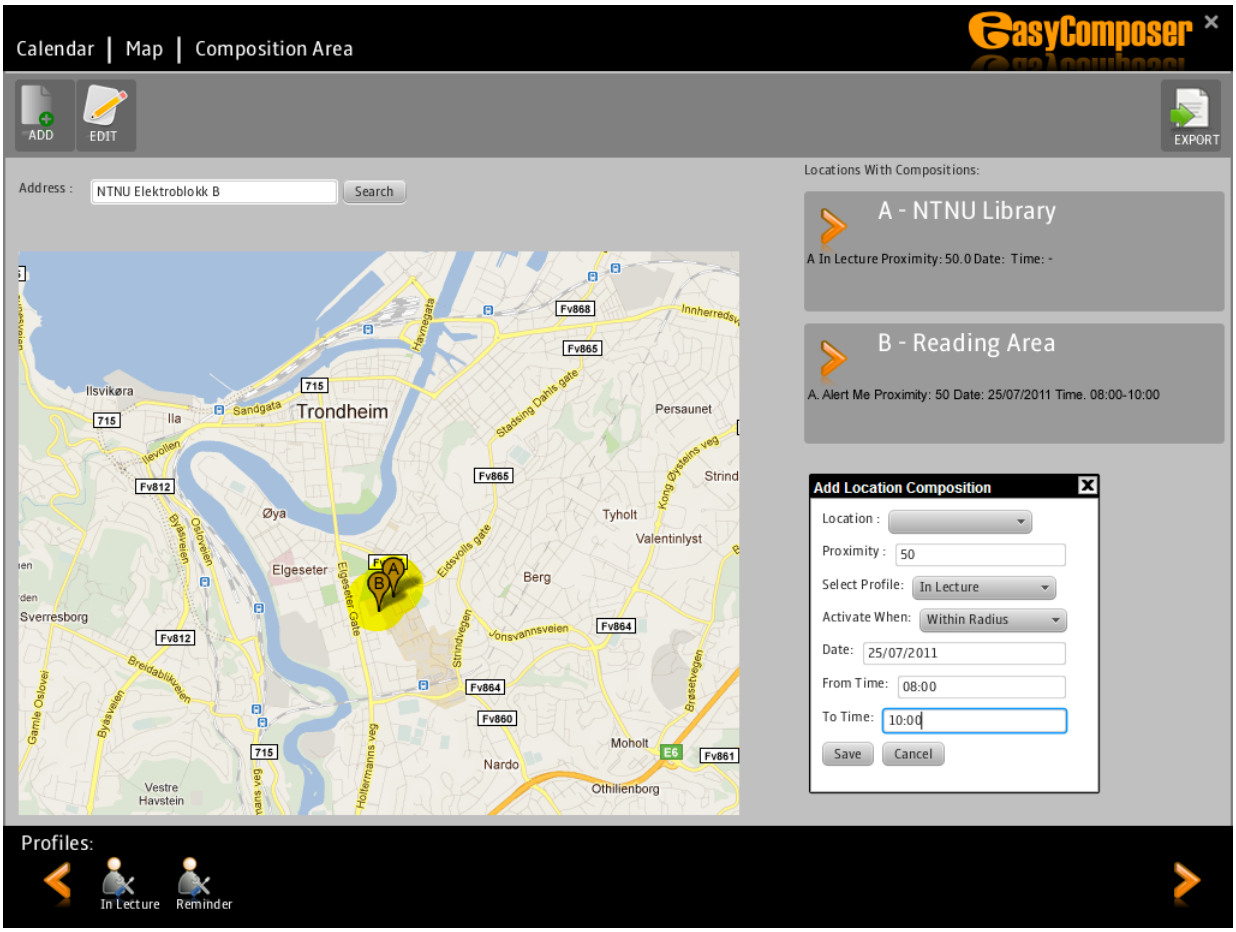

Figure 5-18 Map area location attached with service profile.

In addition Ian will define the locations where he does not want his phone causing disruptions. As shown in Figure 5-18 Ian will select the Locations and in this locations can decide to specify in which times this InLecture profile should work.

5.4.5 Exporting the XML

As with all the previous scenarios when Ian is done with the composition and calendar scheduling activities he has to export the XML that will be used on his android phone. This XML will be deployed to an online server and the phone downloads this XML. The Easy Droid engine will work out when and when not to activate the service compositions created. The XML exported can be viewed in the appendix B4 section. Ian's phone running the Easy Droid will have the following output show in Figure 5-19.

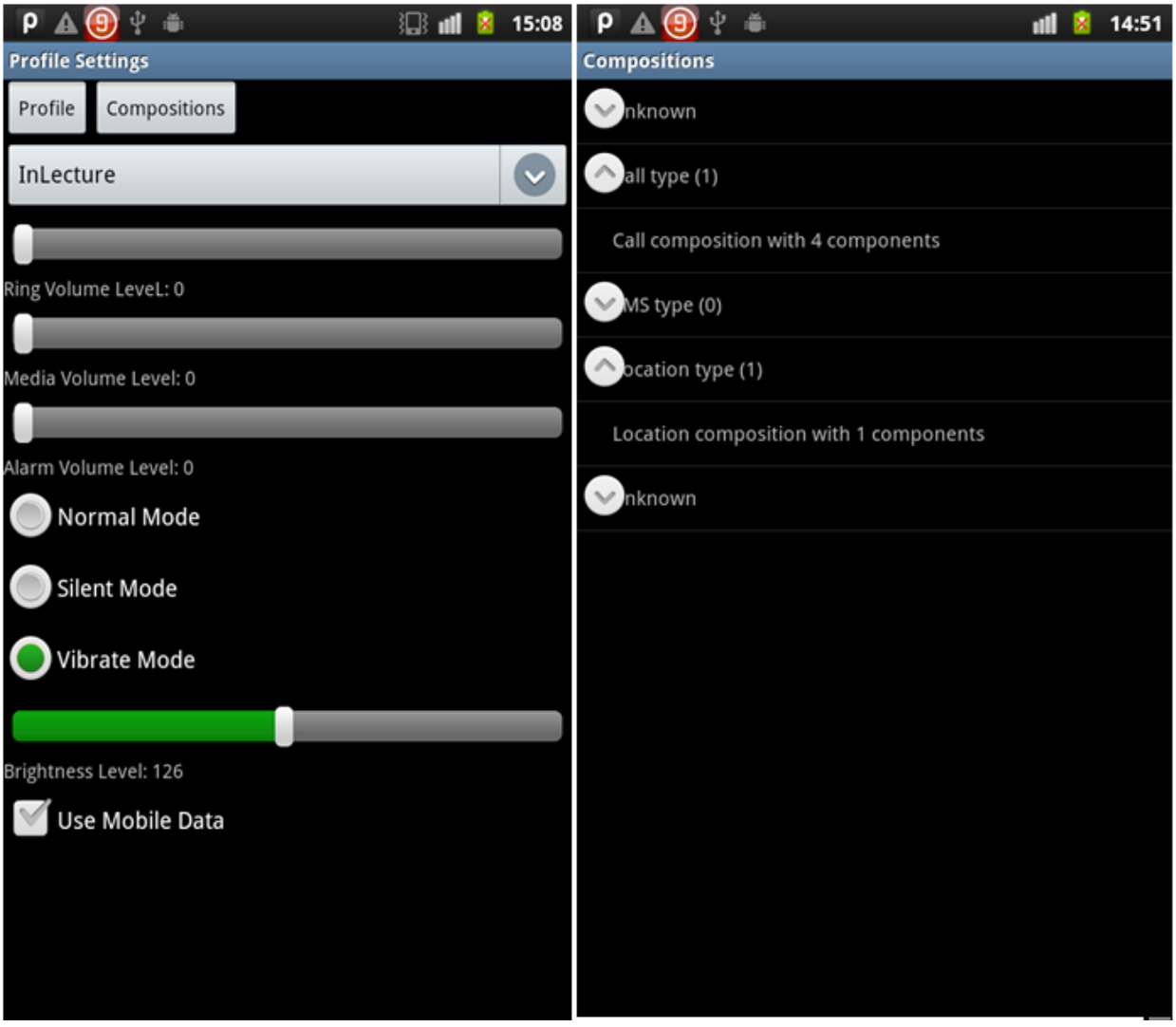

Figure 5-19 Busy Student Scenario Easy Droid Output

5.5 Travelling Businessman Scenario

Drake has identified a problem that he wants to solve by composing a service that can help him run his business efficiently. His major issue has to do with the nature of his job. As he is a travelling businessman he needs to make the best use of his time when out of his country while doing his business. He also needs to minimize the costs that he incurs while he does his job. He has come across a service composition tool that can minimize his problem. He has to compose a service that will help in planning for his meetings as well as minimize his costs, especially his phone usage costs. He therefore begins the process of service composition by looking at the goals and objectives that he needs to meet. This gives him a clear picture of what service he needs. He identifies services and maps them to components existing in the composition tool and finally composing the service.

5.5.1 Goals and objectives:

The identified goals here are to ensure that Drake is able to manage and plan meetings with his clients well and at the same time ensure customer satisfaction by giving customer service when needed.

In addition Drake phone expenses should be minimized by having the phone react according to particular contexts and minimize roaming charges as appropriate, thereby allowing for him to be able to avoid unnecessary charges and at the same time giving the callers an alternative.

5.5.2 Service identification and specification

In essence the service will majorly deal with Drake's location, whereby when there is an incoming call there is a check to see if Drake is roaming or not. If the Drake is roaming then the call is forwarded to a collaborating company who listen to the case. If the case is complex the company calls Drake. If Drake is busy the call is forwarded to the voicemail otherwise Drake picks the call. Also when Drake is roaming the internet connection is disconnected. From the objectives outlined in the scenario, the following services will be required:

- A service that allows for call forwarding, this is in the case that Drake is roaming. The call forwarding service will redirect the caller to a different number that is set by Drake for the collaborating company.
- A service which allows Drake to manage all his planned meetings and will allow for Drake to know when a meeting starts and when a certain meeting should end.
- Settings service which should allow Drake to turn on and off his mobile data connection thus avoiding the internet charges when he is roaming.
- A voicemail service is also required which allows callers to leave messages for Drake when he is unavailable.
- Finally a filtering service is required. This will filter the caller numbers, in that the collaborating companies can be able to get through to either Drake or his Voicemail but all the other users will not be able to get through to Drake in the case he is roaming.

5.5.3 Service Components for Realization

Similarly the next step is to determine how the services identified can be realized. In this case we identify the service components that will be able to achieve the need. Each of these components provides services and capabilities according to the service specifications

The following components are identified:

1. CallTransfer component: This component allows for the forwarding calls to another number. This allows for the clients call to be forwarded to a collaborating company when Drake is roaming.
2. Agenda component: this component consults the agenda to check if you are busy at the moment or not. In this case the agenda component will check if Drake is currently in a meeting or not.
3. VoiceMail component: this component allows for a voice message to be placed for Drake when he is unavailable.

4. V.I.P component: This is a filter component that allows for Drake to receive calls only from certain numbers while others will be forwarded. In this case Drake will get calls from the collaborating companies who are on the list when roaming.

5. Settings Component, that manages some of the phone settings on Drakes phone at any one particular time. It will be able to turn mobile internet on and off when appropriate.

5.5.4 Service Implementation

As in all other scenarios in this step the service components identified are assembled to use their capabilities in the creation of a new service through service composition. Using the Easy Composer, Drake carries out this process of service composition. In the first step Drake composes the telephony services from the composition area within the Easy Composer, then saves this as a service profile. In the step that follows Drakes enters the meetings in the Easy Composer calendar and attaches reminders to remind him of the meetings. Therefore for all the meetings that are outside of Norway will have a service profile suitable for roaming. This will therefore need Drake to set locations in the map area to allow for the phone to change the service profile when he steps outside of Norway. This will allow for Drake to save on telephone coasts. Finally Drake exports an xml that is deployed to his android phone that will be running the Easy Droid.

5.5.4.1 Service profiles Creation:

Here Drake requires creating a service profile that will manage his calls while he is in meetings. In this case if Drake is outside the country the calls from his clients should be diverted to the collaborating companies. In addition these collaborating companies should be able to contact him at any time apart from when he is in meetings where they are diverted to the voicemail. In addition Drake also needs reminders to help remember his upcoming meetings.

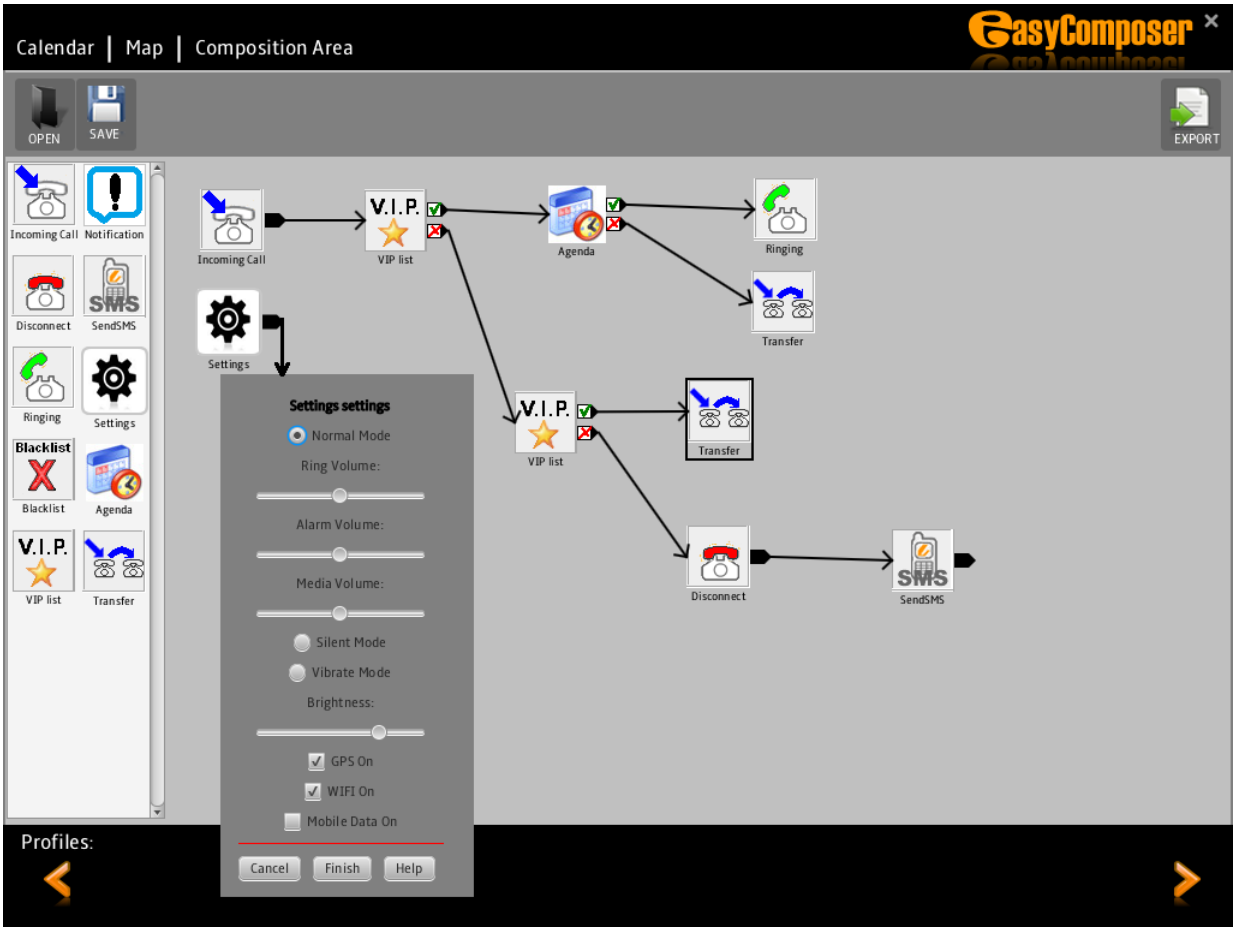

Figure 5-20 Travelling businessmen scenario roaming profile

From the Figure 5-20, Drake composes a service profile whereby when he is roaming and a call is incoming the collaborating companies filter component is invoked which checks whether the incoming call is from a collaborating company. If the caller is not on this V.I.P list the call is forwarded to a second V.I.P filter list which is the clients filter list. This checks if the number belongs to a client. If it is then the number is forwarded to the collaborating company's number, otherwise the call is disconnected and a caller is sent a message stating that Drake is unavailable and gives the caller some numbers they can call if they are clients. If the incoming call is from a collaborating company in the first V.I.P list the agenda component is invoked which checks Drakes calendar to see if he is in a meeting or not. If Drake is in a meeting the call is forwarded to the voicemail number. If drake is not in a meeting then the call is connected.

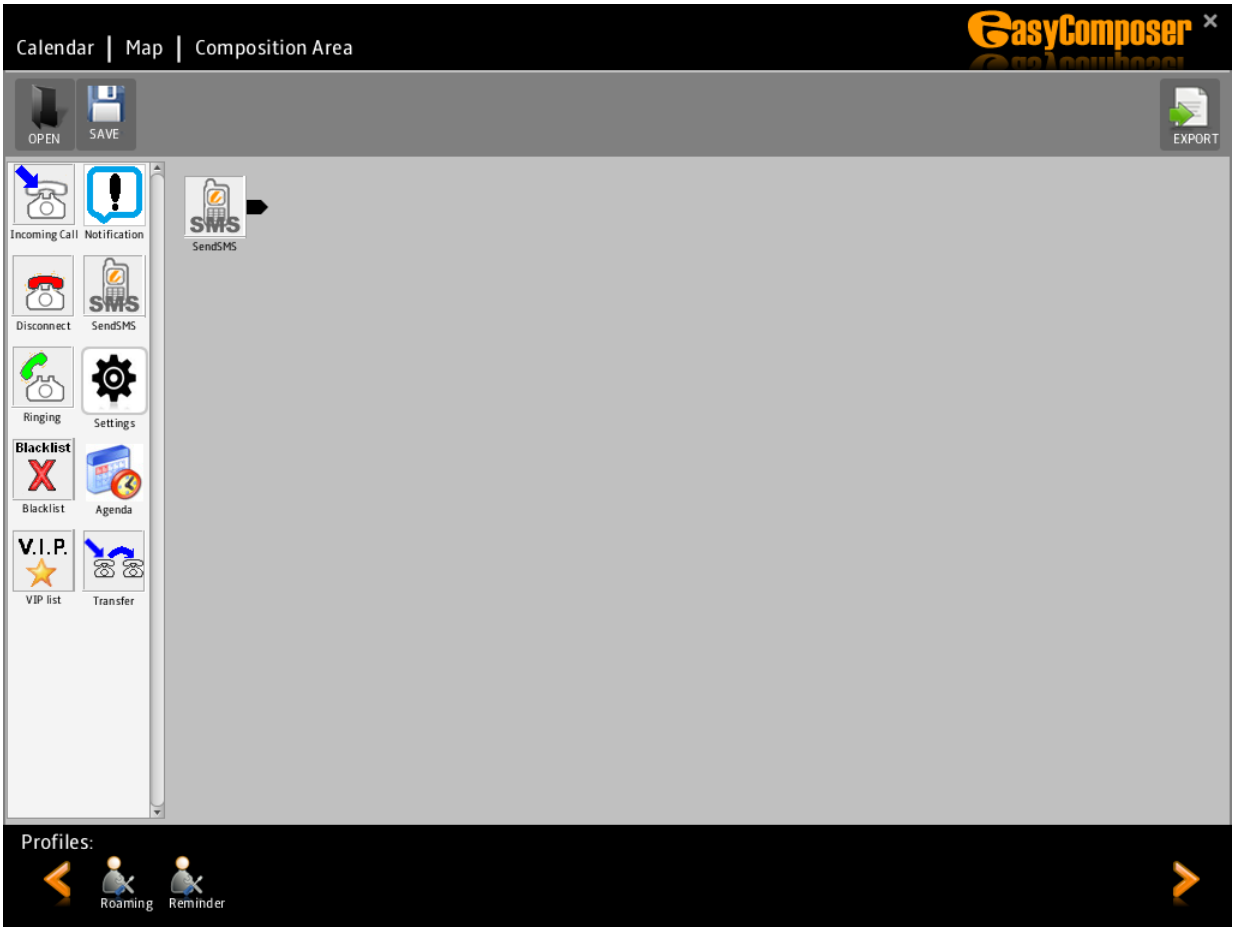

Figure 5-21 Travelling businessmen scenario reminder service

Further as shown on Figure 5-21 Drake creates a service that allows for him to be reminded of all his meetings and this service sends the message to the clients also to remind them of the meeting. This is done early enough to give the chance for the clients to confirm the meeting and in the case they will not be available this will give the client a chance to inform Drake.

5.5.4.2 Time Based Compositions

In order to allow the phone to react to the different contexts Drake has to attach the service profiles to the meetings scheduled in the calendar. He therefore adds the meetings to the calendar as shown in Figure 5-22 and enters reminders for these meetings in advance.

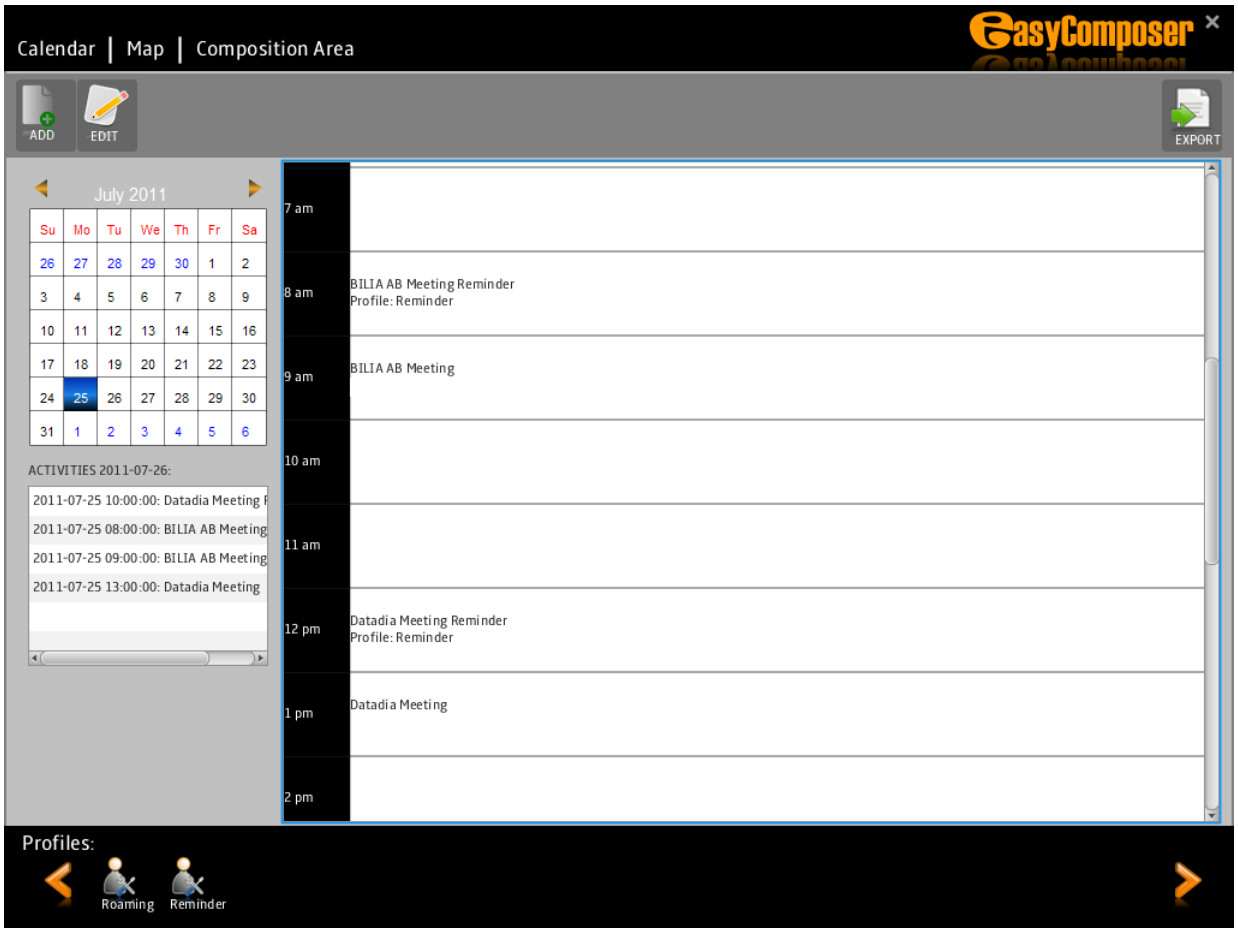

Figure 5-22 Adding meetings and reminders

5.5.4.3 Location Based Compositions

Here Drake will basically select one location which is Norway and therefore set a radius in which he operates and when outside of this radius, then he is roaming. Therefore when outside this radius the phone's profile and settings will change. This is shown on figure 5-23.

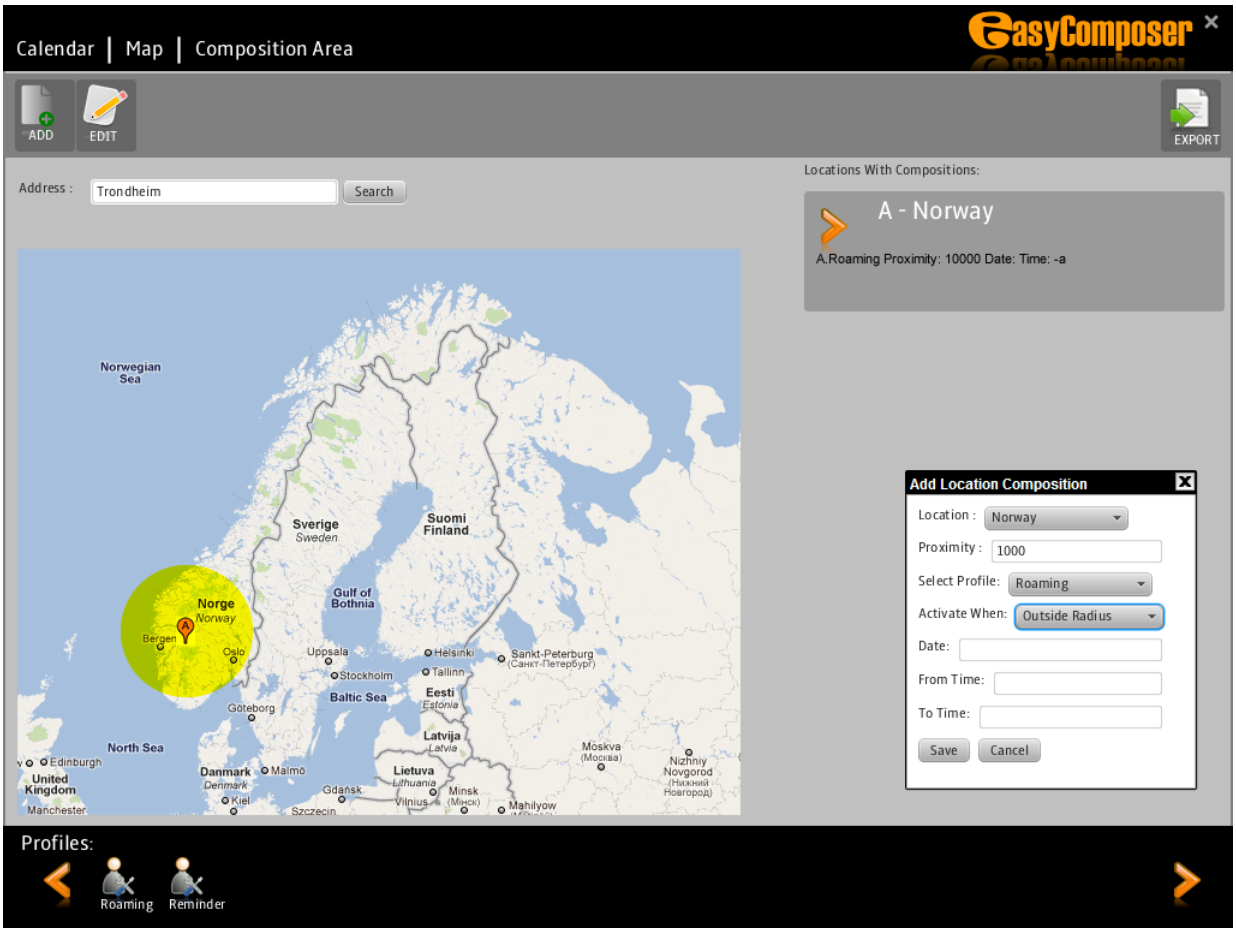

Figure 5-23 Adding locations and attaching the Roaming profile

5.5.5 Exporting the XML

Once Drake is done with the composition and calendar scheduling activities he has to export the XML that will be used on his android smart phone. This is done by simply pressing the export button and this XML is deployed to an online server and finally downloaded on to the android phone and the Easy Droid engine will work out when and when not to activate the service compositions. The XML exported can be viewed in the appendix B5 section. On Drake's phone the output will be as shown in Figure 5-24.

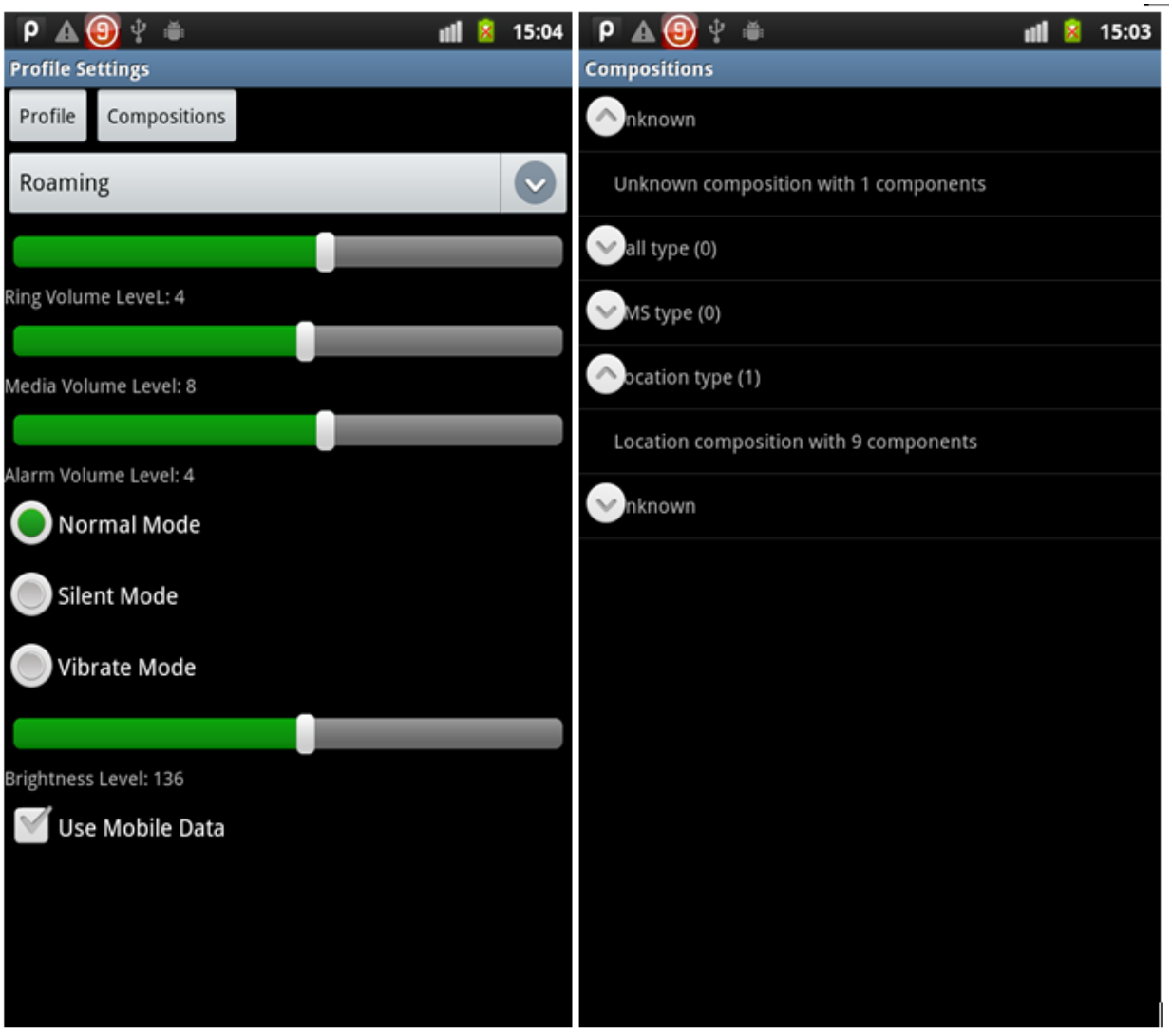

Figure 5-24 Travelling Businessman Scenario Easy Droid Output

5.6 Assessment Results

From the assessment carried with the tool we can fairly say that the end user service composition can be carried out to a high level of satisfaction. Whereby, the personas in the scenarios were able to compose their services. From the assessment carried out the following were the results:

1. In the parental control scenario Jane was able to meet most of her service composition objectives;

Tracking Sophie's Movement: Jane was able to track her daughter's movement and alert messages were sent to her once the daughter entered or left a defined location.

Usage control: In addition Jane was also able to set curfews for her daughter that disallowed the use of the phone at inappropriate times. She was also able to control how the daughter used some of the features such as the internet for example when in school.

Content filters: As the tool did not have a content filtering component she was not able to set content filters. But blocking some of the features that have a likelihood of presenting inappropriate material can suffice, such as disconnecting the internet.

2. In the doctor's appointment scenario, Jane was also able to meet most of her objectives. The tool gave her simple options for helping her mother when going to the doctor. The objectives were met in the following way:

Reminders: Jane was able to set reminders for her mother. This were reminders to tell her when to prepare herself and when she should leave the room. In addition Jane was also able to get reminders of the appointments in order to check up on her mother.

Tracking her mother's movement: Jane was able to make a route schedule that enabled her to track her mother's movement. In addition Jane got alerts when her mother was not at these points within certain times. It helped her monitor her mother's movement. The only limitation was that she was not able to integrate the bus route schedule. This is because the service was not incorporated.

3. In the home delivery scenario Dan was able to meet his objective of creating a service that helped him manage the deliveries. His objectives were met in the following way:

Delivery allocation: Dan was able to allocate deliveries to his deliveries persons. As well as ensure that deliveries were made. The tool ensured that Dan did not double book deliveries or overbook deliveries for a delivery person.

Delivery routing: Dan was able to know if orders were going to get to their destination on time. This was by defining the locations and what time the deliveries were meant to be made. In the case that a delivery person was not at this point an alert was sent. The only setback was that he could not get the traffic information service, in order to get efficient routes to the clients address.

Correct deliveries: The delivery persons are able to check the deliveries in their calendar and confirm the deliveries thus ensuring that they are the correct ones. The delivery person can also check the address on the map in case of doubt.

4. The busy student is able to compose the service required to help in scheduling the day's activities and adding the profiles as required. The student met his objectives in the following way:

Avoid disruptions: Ian was able to avoid disrupting lectures and also causing disturbances in places where the phone should not ring.

Plan his time well: Ian was able to plan his time well as he was able to set his reminders and set a schedule for himself.

5. In the travelling business man scenario, the tool also allowed Drake to compose his required services. He was able to meet his objectives in the following way:

Easily and efficiently plan for meetings: Drake was able to plan for his meetings. Setting up reminders and sending out confirmations to his clients before the meetings. In addition he was able to avoid disruptions during the meetings.

Reduce costs: Drake was also able to save costs by reducing roaming charges. He was able to minimize this by disallowing unnecessary calls and the high internet charges.

Apart from the objectives of the personas in the scenarios, the assessment can also be carried out considering the objectives of the Master's Thesis. Therefore, the following conclusions can be reached:

1. The tool developed was able to support end-user service composition profiles. Whereby users were able to compose services in the composition area and save them to a database and be able to choose them when required. The tool allows for users to access their profiles from anywhere as the tool allows for portability.

2. The user interface design assists the user in composing his/her services. The tool allows the user to compose end user services with ease as it follows sound user interface design principles. The main strength of the system is that it gives the user a context in which they can relate to and also get the importance of end user service composition. This is done through the use of concepts that the user is quite familiar with such as profiles in phones, calendars and maps in their day to day personal management services such as Google maps. Further the icons representing the components give a graphical representation of the service thus the user has an easy time when composing services.

3. Addition of location based compositions has added more user context into the process of service composition thus allowing for greater automation based not only on time but also on locations as well. Since the main aim is for automatic service execution the addition of the location context made this automation even better.

4. The integration between the different parts of the infrastructure was also improved. This was majorly done by improving the XML as this is the only way the different parts of the infrastructure communicate. The addition of simple conflict resolution that ensured to some extent the different parts behaved the way they should. In addition the communication between the parts was automated whereby, when the XML was exported from the Easy Composer it was uploaded to an online server and the phone running the Easy Droid downloaded this XML automatically. This also makes the coordination much easier.

In general the composition process is quite simple thus the objective of end user service composition is met. The problem is brought about when much more complex compositions need to be created. The problem is evident since the users need more services incorporated that are not available for example the traffic information. Another problem that arises is one whereby the compositions can only be composed on the desktop application. This should be possible also in the android environment to make the notion of composing of services on the fly complete. Finally stronger forms of conflict resolution need to be implemented.

6 Discussion

In the view that no single service is able to meet all users' needs, brings about the need for end user service composition. This is because different users have different needs and there these users should specify a service that best meet their needs. Service composition has made the creation of services from existing services possible, but a lot of shortcomings exist. This is because the task of service composition has been left to the people with the technical skills that are needed in composing services. In order for end users to take advantage of service composition techniques should be presented with ways that easily and efficiently allow them to compose services. In this Chapter we look at the achievements in light of the objectives set for the master's thesis in order to come up with a way for end users to compose their services. In addition the chapter looks at the future developments that can improve on the end user composition tool developed.

6.1 Achievements

An infrastructure that allows for end-user service composition was developed. A user-centric approach was carried out in creating this infrastructure in order to ensure that it meets the users' needs. Scenarios were developed to come up with the functional and non-functional requirements of the tool to be created. A few new concepts were also to be introduced in order to make this tool less technical and more usable. Having introduced context aware service composition during the masters project study the main focus in this study was to further develop the tool to allow for location based compositions. This would further add on to the time based service compositions and the service profiles. The service profiles are created by composing services from different telephony services defined as components. The concept of time based compositions was implemented through the use of a calendar which allows service profiles to be integrated in the environment of the users through time. The following were achieved during this study:

1. Scenarios were developed that allowed for the identification of both functional and nun-functional requirements of further developing an infrastructure that best allows for end user service composition. The development of these scenarios followed a user-centric design approach that allowed for a comprehensive way of gathering requirements that were user centered.

2. An end user service composition tool was created that allows for users to compose services. This tool was created with usability principles in consideration thus allowing for a more user friendly tool that made the process of end-user service composition much easier.

3. Location based compositions were also introduced into the infrastructure thus allowing for the location context to be incorporated in the service composition process. This gives the user a clearer and easier way of composing services through the use of maps. Using everyday familiar concepts makes this process easy.

4. The tool was also evaluated using scenario based evaluation techniques to ensure that the system met both its functional and non-functional requirements. The evaluation technique was to check whether the tool made it possible to compose services and see if the tool was usable.

5. Also the inconsistencies that existed previously were eliminated by improving the integration between the different components within the infrastructure for end-user service composition. This was done by improving the XML definition that is used in the transfer of composition from the P.C to the phone. This was further improved by allowing the exportation of these compositions was done directly to the phone by uploading the XML to an online server and the phone would automatically download these XML.

6. In addition basic conflict resolution was also introduced in the tool. This was to allow for the different concepts of time and location to be able to work together when composing services. This simple conflict resolution tried to answer the question what criteria is be used when locations and time define different actions.

Having been presented with an infrastructure that contained different tools for service composition, the idea was to find a way in which the users could make use of the tool as it was deemed unusable. In addition there existed very many inconsistencies between these components. Therefore from the achievements mentioned we can say that an infrastructure was created that allowed end users to compose services much more easily following a more realistic approach that allows end-users to appreciate the concept of end-user service composition.

6.2 Future Development

Based on the work carried out on the project the following can be areas of future development that can make the tool more usable in end user service composition.

- The composition tool can further be developed to incorporate other forms of context and services. In this case the use of web services such as traffic services and bus route services would make it a more useful tool. This would improve the practical use of the application as it will give users more options.

- In addition a more efficient and reliable conflict mechanism should be created that is able to handle more complex compositions by end users. This will thereby ensure the combination of many different compositions will be error free and that the engine can still function in the intended way.

- Some functionality in phones might not be controlled. This is because some of the phone vendors do not allow for it while others are due to the service operators. Therefore control should be moved from the application level on the phone and to the network in order to allow more control and also allow for more services to be incorporated into the tool.

- Even though the Smartphone market is dominated by android products, the tool can also be tailored to also be used with other operating systems such as iPhone. It should also allow for the use with feature phones as well, where they can be allowed to compose simpler services, if they do not have the needed features to create more complex composition scenarios.

- Due to the separation of the structure of the application into two parts. A user interface for mobile devices that allows for service composition should be developed so that the end-users will be able to change the behavior on the go thus making the main goal of service composition on the fly more realistic instead of having to switch from one application to another.
- Since the application is to be used by users experimenting the tool in a real environment may also play an insight on what improvements need to be made. It can also make an insight onto the user behaviors and reactions on the field of end-user service composition in light to the current trends where all composition is left for the operators.

7 Conclusion

A tool for end-user service composition is presented, that has been created following user-centric design approaches. Using a scenario based approach, scenario are generated that are used to come up with the requirements, thereby ensuring the tool has high level of usability by providing realistic and practical approaches towards end-user service composition. The tool has been created as an improvement of an existing infrastructure with the aim of identifying approaches which can enable ordinary users who have no significant modeling and programming skills to compose services.

Among the advantages of our approach we mention, including the idea of context that users can relate to. For instance maps and calendars are concepts that end-users are very familiar with therefore giving the user a more practical approach to composing services. Further contextual information is attached to the services created whereby services composed were saved as profiles which are used in a calendar and a map thus making the service composition context aware. Most importantly the approach followed ensures that usability principles are implemented to ensure that the tool in itself has a high level of usability to ensure that the users can not only understand the concept of end-service composition but they can also appreciate its importance in their everyday life.

The future work to be carried out will mainly focus on the incorporation of users in the testing process to see that the system is usable as perceived. In addition newer approaches to end-user service composition should also be incorporated into the tool. This will basically be on adding more context information as well as more services.

Appendix

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Appendix B: XML Representations

B1: Parental Control Scenario Exported XML

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<Compositions>
<Composition type="3" firstCid="0">
<Criterias>
<Criteria id="0" name="Home">
<Time fromtime= " " totime= " "/>
<Location address= "Moholt Trondheim" longitude= "10.436171" latitude=
"63.4095" radius= "50.0" activate= "Within Radius"/>
</Criteria>
<Criteria id="1" name="Friends Place">
<Time fromtime= " " totime= " "/>
<Location address= "Tyholt Trondheim" longitude= "10.437476" latitude=
"63.42461" radius= "50.0" activate= "Within Radius"/>
</Criteria>
<Criteria id="2" name="School">
<Time fromtime= " " totime= " "/>
<Location address= "Berg Trondheim" longitude= "10.422839" latitude=
"63.420616" radius= "50.0" activate= "Within Radius"/>
</Criteria>
</Criterias><Component type="sendSMS" posx="174.0" posy="73.0"
isMovable="true" name="SendSMS" cid="0" specificsNotSpecified="true">
</Component>
</Composition>

<Composition type="1" firstCid="1">
<Criterias>
<Criteria id="0" name="Curfew">
```

```
<Time fromtime= "20110725 08:00:00" totime= "20110725 17:00:00"/>
<Location address= "Berg Trondheim" longitude= "10.422839" latitude=
"63.420616" radius= "50.0" activate= "Within Radius"/>
</Criteria>
<Criteria id="0" name="School">
<Time fromtime= " " totime= " "/>
<Location address= "Berg Trondheim" longitude= "10.422839" latitude=
"63.420616" radius= "50.0" activate= "Within Radius"/>
</Criteria>
</Criterias><Component type="Settings" posx="150.0" posy="17.0"
isMovable="true" name="Settings" cid="2" specificsNotSpecified="true">
</Component>
<Component type="IncomingCall" posx="154.5" posy="121.0"
isMovable="true" name="Incoming Call" cid="3"
specificsNotSpecified="true">
<Connector cbid="0" nextCid="1" />
</Component>
<Component type="viplist" posx="327.0" posy="128.0" isMovable="true"
name="VIP list" cid="1" specificsNotSpecified="true">
<Connector cbid="0" nextCid="4" />
<Connector cbid="1" nextCid="5" />
</Component>
<Component type="Connect" posx="517.0" posy="96.0" isMovable="true"
name="Ringing" cid="4" specificsNotSpecified="true">
</Component>
<Component type="Disconnect" posx="521.0" posy="238.0"
isMovable="true" name="Disconnect" cid="5"
specificsNotSpecified="true">
</Component>
</Composition>

</Compositions>
```

B2: Doctor's Appointment Scenario Exported XML

```
<Compositions>
<Composition type="3" firstCid="0">
<Criterias>
<Criteria id="0" name="Home">
<Time fromtime= "Mon Jul 25 00:00:00 CEST 2011 Thu Jan 01 10:00:00 CET
1970" totime= "Mon Jul 25 00:00:00 CEST 2011 Thu Jan 01 10:15:00 CET
1970"/>
<Location address= "Tyholt Trondheim" longitude= "10.437476" latitude=
"63.42461" radius= "50.0" activate= "Outside Radius"/>
</Criteria>
<Criteria id="1" name="Home">
<Time fromtime= "Mon Jul 25 00:00:00 CEST 2011 Thu Jan 01 12:45:00 CET
1970" totime= "Mon Jul 25 00:00:00 CEST 2011 Thu Jan 01 13:00:00 CET
1970"/>
<Location address= "Tyholt Trondheim" longitude= "10.437476" latitude=
"63.42461" radius= "50.0" activate= "Outside Radius"/>
</Criteria>
<Criteria id="2" name="Eidsvolls Gate">
<Time fromtime= "Mon Jul 25 00:00:00 CEST 2011 Thu Jan 01 10:15:00 CET
1970" totime= "Mon Jul 25 00:00:00 CEST 2011 Thu Jan 01 10:30:00 CET
1970"/>
<Location address= "Eidsvolls Gate Trondheim" longitude= "10.412143"
latitude= "63.422253" radius= "50.0" activate= "Outside Radius"/>
</Criteria>
<Criteria id="3" name="Vollabakken">
<Time fromtime= "Mon Jul 25 00:00:00 CEST 2011 Thu Jan 01 10:30:00 CET
1970" totime= "Mon Jul 25 00:00:00 CEST 2011 Thu Jan 01 10:45:00 CET
1970"/>
<Location address= "Vollabakken Trondheim" longitude= "10.400381"
latitude= "63.42308" radius= "50.0" activate= "Outside Radius"/>
</Criteria>
<Criteria id="4" name="St. Olavs Hospital">
```

<Time fromtime= "Mon Jul 25 00:00:00 CEST 2011 Thu Jan 01 10:45:00 CET 1970" totime= "Mon Jul 25 00:00:00 CEST 2011 Thu Jan 01 11:00:00 CET 1970"/>
<Location address= "St Olavs hospital Trondheim" longitude= "10.389161" latitude= "63.420475" radius= "50.0" activate= "Outside Radius"/>
</Criteria>
<Criteria id="5" name="St. Olavs Hospital">
<Time fromtime= "Mon Jul 25 00:00:00 CEST 2011 Thu Jan 01 12:00:00 CET 1970" totime= "Mon Jul 25 00:00:00 CEST 2011 Thu Jan 01 12:15:00 CET 1970"/>
<Location address= "St Olavs hospital Trondheim" longitude= "10.389161" latitude= "63.420475" radius= "50.0" activate= "Outside Radius"/>
</Criteria>
<Criteria id="6" name="Vollabakken">
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<Location address= "Vollabakken Trondheim" longitude= "10.400381" latitude= "63.42308" radius= "50.0" activate= "Outside Radius"/>
</Criteria>
<Criteria id="7" name="Eidsvolls Gate">
<Time fromtime= "Mon Jul 25 00:00:00 CEST 2011 Thu Jan 01 12:30:00 CET 1970" totime= "Mon Jul 25 00:00:00 CEST 2011 Thu Jan 01 12:45:00 CET 1970"/>
<Location address= "Eidsvolls Gate Trondheim" longitude= "10.412143" latitude= "63.422253" radius= "50.0" activate= "Outside Radius"/>
</Criteria>
</Criterias><Component type="sendSMS" posx="174.0" posy="73.0" isMovable="true" name="SendSMS" cid="0" specificsNotSpecified="true">
</Component>
</Composition>

<Composition type="3" firstCid="0">

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<Criterias>
<Criteria id="0" name="Prepare for Doctors Appointment">
<Time fromtime= "20110725 09:00:00" totime= "20110725 10:00:00"/>
</Criteria>
<Criteria id="1" name="Leave House for Doctors Appointment">
<Time fromtime= "20110725 10:00:00" totime= "20110725 11:00:00"/>
</Criteria>
</Criterias><Component    type="sendSMS"    posx="174.0"    posy="73.0"
isMovable="true" name="SendSMS" cid="1" specificsNotSpecified="true">
</Component>
</Composition>

</Compositions>
```

B3: Home Delivery Scenario Exported XML

```
<Compositions>
<Composition type="3" firstCid="0">
<Criterias>
<Criteria id="0" name="Herman Kragsvei 8-23">
<Time fromtime= "Mon Jul 25 00:00:00 CEST 2011 Thu Jan 01 16:00:00 CET 1970" totime= "Mon Jul 25 00:00:00 CEST 2011 Thu Jan 01 17:00:00 CET 1970"/>
<Location address= "Herman Kragsvei 8-23 " longitude= "10.43223" latitude= "63.4127" radius= "50.0" activate= "Outside Radius"/>
</Criteria>
</Criterias><Component type="sendSMS" posx="174.0" posy="73.0" isMovable="true" name="SendSMS" cid="0" specificsNotSpecified="true">
</Component>
</Composition>

<Composition type="3" firstCid="0">
<Criterias>
<Criteria id="0" name="Prepare Delivery 1: 1 pack fresh apples, 2kg fresh cabbage, 0.5 kg fresh carrots, 1 kg fresh culiflower, 1 kg fresh celery">
<Time fromtime= "20110725 15:00:00" totime= "20110725 16:00:00"/>
</Criteria>
</Criterias><Component type="sendSMS" posx="174.0" posy="73.0" isMovable="true" name="SendSMS" cid="1" specificsNotSpecified="true">
</Component>
</Composition>

<Composition type="3" firstCid="0">
<Criterias>
<Criteria id="0" name="Confirm Delivery 1: 1 pack fresh apples, 2kg fresh cabbage, 0.5 kg fresh carrots, 1 kg fresh culiflower, 1 kg fresh celery">
<Time fromtime= "20110725 14:00:00" totime= "20110725 15:00:00"/>
```

```
</Criteria>
</Criterias><Component    type="sendSMS"    posx="174.0"    posy="73.0"
isMovable="true" name="SendSMS" cid="2" specificsNotSpecified="true">
</Component>
</Composition>

</Compositions>
```

B4: Busy Student Scenario Exported XML

```
<Compositions>
<Composition type="1" firstCid="0">
<Criterias>
<Criteria id="0" name="Service Intelligence and Mobility">
<Time fromtime= "20110725 13:00:00" totime= "20110725 15:00:00"/>
</Criteria>
<Criteria id="1" name="Information Security">
<Time fromtime= "20110725 10:00:00" totime= "20110725 12:00:00"/>
</Criteria>
<Criteria id="0" name="Library">
<Time fromtime= " " totime= " "/>
<Location address= "NTNU Hovedbygningen " longitude= "10.402362"
latitude= "63.41924" radius= "50.0" activate= "Within Radius"/>
</Criteria>
<Criteria id="1" name="Reading Area">
<Time fromtime= " " totime= " "/>
<Location address= "Elektroblokk C" longitude= "10.399949" latitude=
"63.418686" radius= "50.0" activate= "Within Radius"/>
</Criteria>
</Criterias><Component type="Settings" posx="160.0" posy="198.0"
isMovable="true" name="Settings" cid="1" specificsNotSpecified="true">
</Component>
<Component type="IncomingCall" posx="153.5" posy="25.0"
isMovable="true" name="Incoming Call" cid="2"
specificsNotSpecified="true">
<Connector cbid="0" nextCid="0" />
</Component>
<Component type="Disconnect" posx="293.0" posy="26.0" isMovable="true"
name="Disconnect" cid="0" specificsNotSpecified="true">
<Connector cbid="0" nextCid="3" />
</Component>
<Component type="sendSMS" posx="446.0" posy="28.0" isMovable="true"
name="SendSMS" cid="3" specificsNotSpecified="true">
```

```
<Connector cbid="0" nextCid="4" />
</Component>
<Component type="Notification" posx="595.0" posy="16.0"
isMovable="true" name="Notification" cid="4"
specificsNotSpecified="true">
</Component>
</Composition>

<Composition type="3" firstCid="-1">
<Criterias>
<Criteria id="0" name="Library">
<Time fromtime= " " totime= " "/>
<Location address= "NTNU Hovedbygningen " longitude= "10.402362"
latitude= "63.41924" radius= "50.0" activate= "Within Radius"/>
</Criteria>
</Criterias><Component type="sendSMS" posx="174.0" posy="73.0"
isMovable="true" name="SendSMS" cid="5" specificsNotSpecified="true">
</Component>
</Composition>

</Compositions>
```

B5: Travelling Businessman Scenario Exported XML

```
<Compositions>
<Composition type="3" firstCid="0">
<Criterias>
<Criteria id="0" name="BILIA Ab Meeting Reminder">
<Time fromtime= "20110725 08:00:00" totime= "20110725 10:00:00"/>
</Criteria>
<Criteria id="1" name="Data Meeting Reminder">
<Time fromtime= "20110725 12:00:00" totime= "20110725 13:00:00"/>
</Criteria>
</Criterias><Component type="sendSMS" posx="174.0" posy="73.0"
isMovable="true" name="SendSMS" cid="0" specificsNotSpecified="true">
</Component>
</Composition>

<Composition type="3" firstCid="0">
<Criterias>
<Criteria id="0" name="Norway">
<Time fromtime= " " totime= " "/>
<Location address= "Norge" longitude= "8.468946" latitude= "60.472023"
radius= "1000.0" activate= "Outside Radius"/>
</Criteria>
</Criterias><Component type="IncomingCall" posx="214.5" posy="32.0"
isMovable="true" name="Incoming Call" cid="9"
specificsNotSpecified="true">
<Connector cbid="0" nextCid="1" />
</Component>
<Component type="viplist" posx="344.0" posy="43.0" isMovable="true"
name="VIP list" cid="1" specificsNotSpecified="true">
<Connector cbid="0" nextCid="2" />
<Connector cbid="1" nextCid="3" />
</Component>
<Component type="Agenda" posx="498.0" posy="44.0" isMovable="true"
name="Agenda" cid="2" specificsNotSpecified="true">
```

```
<Connector cbid="0" nextCid="4" />
<Connector cbid="1" nextCid="5" />
</Component>
<Component type="Connect" posx="640.0" posy="54.0" isMovable="true"
name="Ringing" cid="4" specificsNotSpecified="true">
</Component>
<Component type="Transfer" posx="643.0" posy="170.0" isMovable="true"
name="Transfer" cid="5" specificsNotSpecified="true">
</Component>
<Component type="viplist" posx="501.0" posy="259.0" isMovable="true"
name="VIP list" cid="3" specificsNotSpecified="true">
<Connector cbid="0" nextCid="6" />
<Connector cbid="1" nextCid="7" />
</Component>
<Component type="Transfer" posx="667.0" posy="256.0" isMovable="true"
name="Transfer" cid="6" specificsNotSpecified="true">
</Component>
<Component type="Disconnect" posx="659.0" posy="399.0"
isMovable="true" name="Disconnect" cid="7"
specificsNotSpecified="true">
<Connector cbid="0" nextCid="8" />
</Component>
<Component type="sendSMS" posx="839.0" posy="403.0" isMovable="true"
name="SendSMS" cid="8" specificsNotSpecified="true">
</Component>
<Component type="Settings" posx="191.0" posy="159.0" isMovable="true"
name="Settings" cid="10" specificsNotSpecified="true">
</Component>
</Composition>

</Compositions>
```