



Education and Culture DG

Lifelong Learning Programme

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Using wireless technologies for context sensitive education and training

Local System Design

Summary

Mobile learning represents exciting new frontiers in education and pedagogy. With the features of 'wearable' computing and multimedia content delivery via mobile technologies, mobile learning provides new benefits to instructors and learners such as ubiquitous learning that can connect instructors and learners in both traditional classroom and online settings.

In order to satisfy the requirements of the CONTSENS project, Giunti Labs and Ericsson have conducted a detailed investigation of the technologies and methodologies needed, including systems still under definition, for example IMS (IP Multimedia Subsystem).

This document outlines the local system design of the solution proposed by Giunti Labs and Ericsson for the development and deployment of context sensitive, location based training.

Introduction

Mobile communication technologies are rapidly evolving to include local area wireless connections using Wi-Fi, Third Generation (3G) mobile technology, Worldwide Interoperability for Microwave Access (WiMAX) and related mobile computing devices such as smart phones, Pocket PCs, tablet PCs, and various Personal Data Assistants (PDAs) handheld devices.

The development software proposed for use in this project – eXact Mobile - enables access to an LMS with mobile UMTS, Wi-Fi and GPRS devices. This allows the learner to access

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Learning Objects and learning paths specifically customized for the available peripherals and for the location of access.

eXact Mobile is the first commercial mobile Learning Content Management Solution. It is a module of learn eXact that enables context-aware learning content delivery when the learner needs to access it.

eXact Mobile takes advantage of mobile devices and wireless connections to provide attractive learning environments and experiences, enabling:

- Ubiquity; students can login to course content 24 hours a day, 365 days a year, wherever they are.
- Authoring; packaging and delivering of mobile learning content.
- SCORM tracking.
- Smart tags based content retrieval.
- Location-based detection with Wi-Fi networks and GPS.
- Hands free, voice and eye controlled wearable PC access.
- Social networked and collaborative tool integration.
- Feedback (polling, quizzes, etc.) to tutors/administrators.
- Analysis of actions performed by the users.

eXact Mobile can be integrated with the learn eXact LCMS suite or interfaced with any 3rd party eLearning (LMS/VLE) solution. eXact Mobile provides access to the LMS through mobile UMTS Wi-Fi and GPRS devices, providing a high level of flexibility in learning programmes planning.

eXact Mobile also feeds tracking information back to the LMS allowing the learner or mobile worker to follow learning programmes using the most convenient device available.

Mobile content creation

eXact Packager is a professional content development tool. It is a powerful client/server Windows™ application which empowers editors to easily create, tag and publish Reusable Information Assets (RIAs), Reusable Learning Objects (RLOs) and Reusable Content Packages (RCPs) and structures (templates).

eXact Packager enables ingesting pre-existing assets from all main legacy and editorial formats (for example Word and Power Point) and converting them into multi-delivery publication packages which can include "traditional" formats (e.g. offline CDs and pdf documents), streamline e-learning formats (e.g. HTML and SCORM web based training courseware) and future proof conversion towards all digital media (for example Mobile, Virtual and TV Learning).

Mobile technologies are the next step in the evolution of technology-mediated teaching and learning. They not only connect people in information-driven society effectively, but they also offer the opportunity for spontaneous, personal, informal, and situated learning. eXact Packager allows the strategic production of the mobile content, applications, and resources necessary to support anywhere-anytime connections to formal and situational learning, as well as personal interest explorations.

Using the eXact Packager LCMS authoring tool the author can create and deliver SCORM courses (containing SCORM content) on mobile devices. All courses produced are compliant with the IMS CP specification.

eXact Packager follows the compiling model, developing learning content in suitable formats for a user's learning environment where required.

The partners' production philosophy is based on building Learning Object Models and Templates using these tools.

A Learning Object Model could be seen as a LEGO construction, where every single LEGO brick is an asset that can be used to create different kinds of structures. In a similar way different types of assets can be used to build Learning Objects using the Templates and then can be adapted to different devices.

From the development point of view, an LO model is a software pack that defines:

- The user interface and its functionalities.
- The navigation and tracking rules.
- The set of content formats or templates.

A template is a model for a single content, and it is defined by an interface, its functionalities, a set of input data, and a set of parameters.

There are some specific Learning Object Models to use such as J2ME. LO models are used to create Learning Objects for the Java Platform, Micro Edition (Java ME) which provides the environment for applications running on mobile phones, PDAs, TV set-top boxes, and other devices.

Learning Object and Devices

Several Learning Object Models are available which enable developers to create, pack and publish content according to the mobile device and network technology.

SCORM learning objects and packages can be delivered to market leading mobile devices such as:

- Personal Digital Assistant
- Feature phones (compliant with Java™ 2 Platform, Micro Edition)
- Smartphones and Blackberries.

To design, develop and deliver mobile content, the partners have developed a series of Mobile Learning Object models and templates for content production teams which are organized by device and technology.

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Scenario description and feasibility study

As part of this Local System design, the partners agreed on a typical training situation in which they could test and evaluate the course content. The scenario selected for development and testing is as follows:

Cormac is a telecommunications field engineer. He is out in the field fixing a particular node. When he arrives on site, the training delivery system knows where he is and recognizes the correct revision of the node that he is working on. Cormac can access information relevant to that specific node.

CONTSENS: first integration of eXact Mobile and IMS technology

In order to satisfy the requirements of the CONTSENS project, Giunti Labs and Ericsson have conducted a detailed investigation into the technologies and methodologies that could be used for content development. This should include the option to use different systems which are still under definition, for example IMS technology.

As mentioned in the General System Design, IMS is still being rolled out across mobile networks worldwide, in particular the IMS Location Server (ILS) is not due for release until Q1 2009. Consequently the first phase of development work will focus on existing GSM/WCDMA networks and GPS .

The partners' solution for CONTSENS is a Java™ 2 Platform, Micro Edition application based on the graphic library LWUIT: this is a UI library bundled together with applications and it helps content developers in creating compelling and consistent Java™ 2 ME applications. LWUIT supports visual components and other UI features such as theming, transitions, animation and more.

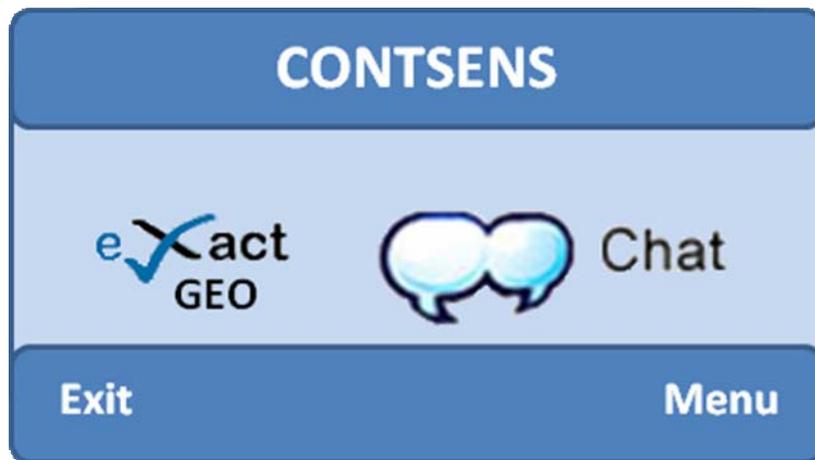


Figure 1 – CONTSENS solution.

Figure 1 displays a screenshot of the CONTSENS solution: there are two icons, one for the IMS chat application and one for eXact GEO, the eXact Mobile customized for CONTSENS.

The CONTSENS solution is composed by a Root Application (RA), a Navigation Bar (NB) and a set of Children Applications (CA).

The Root Application is a portal of CAs: in fact RA allows loading one or more CAs, RA allows loading only one CA instance and RA is able to close itself after the CAs closure. The Navigation Bar stores the list of running CA: then NB is always visible except when the list is empty, NB shows the list of the A that are running in background and NB allows switching to an A that is running in background.

The Child Application can be based on IMS technology, it is able to close itself and highlights the last CA started.

eXact GEO is a CA and is not based on IMS technology.

CONTSENS Use Case

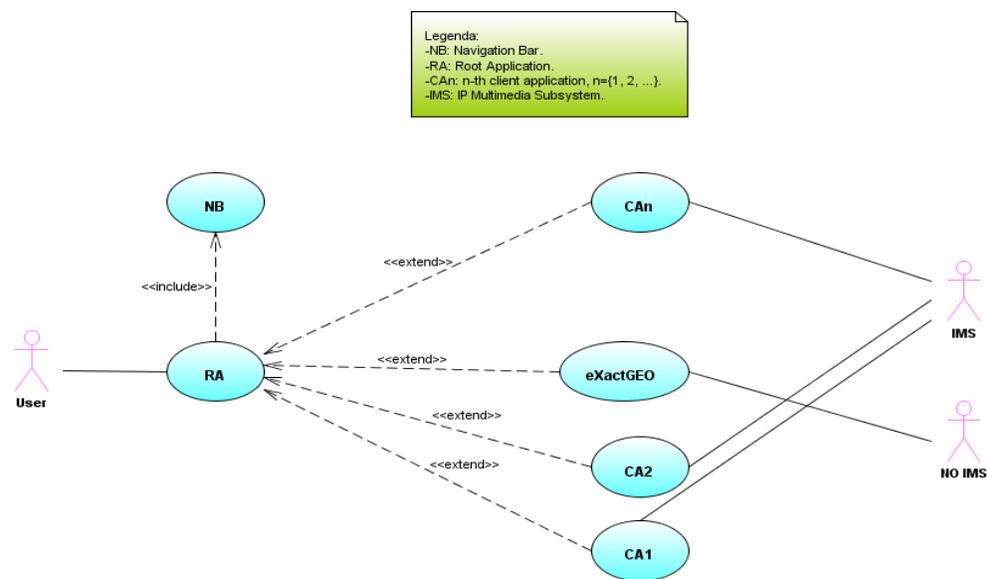


Figure 2 – Use Case.

Figure 2 represents the CONTSENS solution from the perspective of the users of the system. The actor User is a human, the actors IMS and NO IMS are systems.

The use case RA is the main activity that CONTSENS solution performs for the User, the use cases CAs are the main activities that CONTSENS solution performs for the IMS and NO IMS. The RA depends on NB and is extended by CAs, which means each CA depends on NB.

CONTSENS Class Diagram

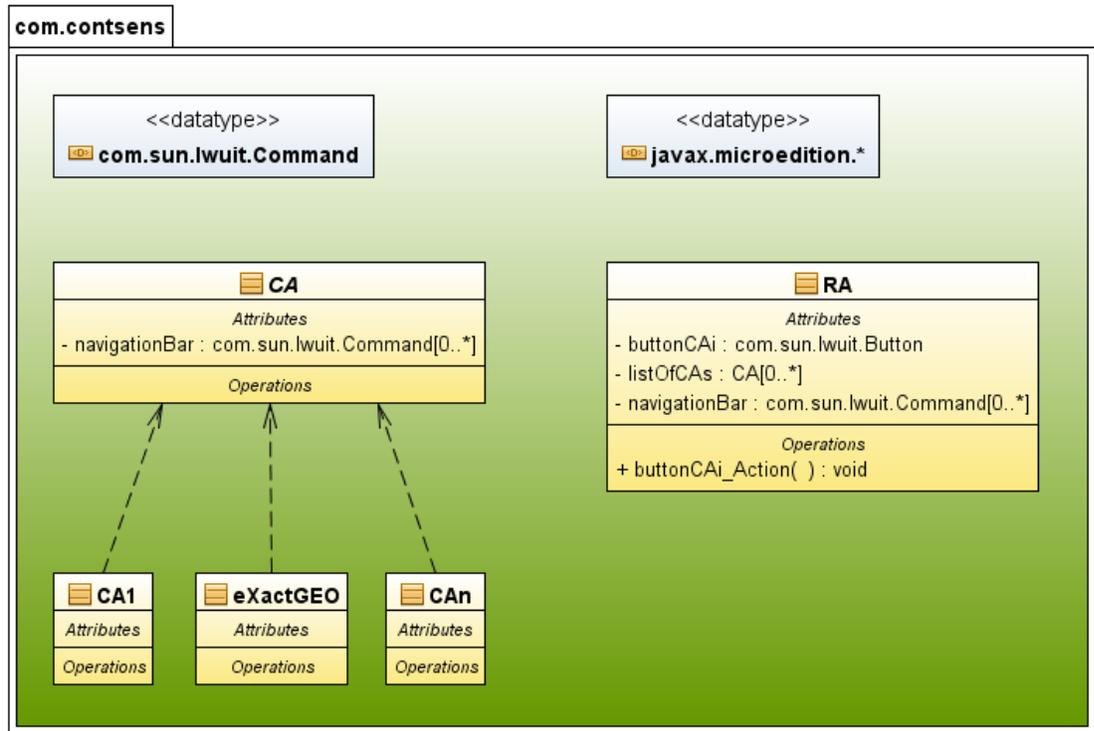


Figure 3 – Class Diagram.

The diagram in Figure 3 has been designed to highlight the Graphical User Interface (GUI) of the CONTSENS solution.

The CONTSENS solution is based on J2ME™ and LWUIT technologies. The main java package is com.contsens which wraps a RA class, a CA abstract class super class of a set of CAs classes and eXactGEO class.

RA is the main form of the CONTSENS solution and it is displayed as GUI. RA has a title, a set of buttons and a NB. Each button has a label, an icon and is able to receive select/click key events. The select/click key event is associated to start a CA and displays CA as GUI.

CA has a title, a GUI application and a NB.
 NB is a menu on the bottom-right of each A. NB has the title “Switch” and is able to receive select/click key events. The select/click key event is associated to switch to a CA running in background. CA is the father of all CAs and any of them shows a GUI title and a GUI NB.

CONTSENS Sequence Diagram

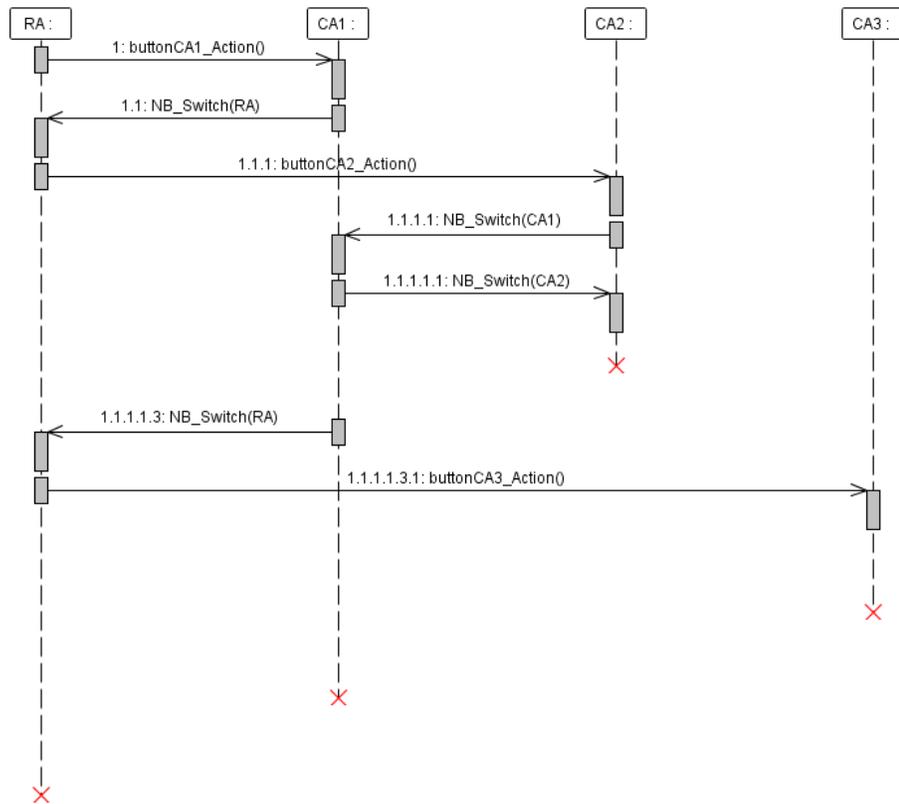


Figure 4 – Sequence Diagram.

Figure 4 represents a sequence diagram that displays the messages exchanged between the applications to switch between them.

The CONTSENS solution is composed of RA, CA₁, CA₂ and CA₃.

The first application is RA, and then the message 1 triggers CA₁ and displays it. Now the NB contains only the RA item.

Message 1.1 switches to RA and displays it. Then the NB contains only the item CA₁.

Message 1.1.1 triggers CA₂ and displays it. Now the NB contains the items RA and CA₁.

The message 1.1.1.1 switches to CA₁ and displays it. Then the NB contains the items RA and CA₂.

Message 1.1.1.1.1 switches to CA₂ and displays it: the NB contains the items RA and CA₁.

The exit command on CA₂ switches automatically to the last started application, in this case CA₁. Then the NB contains only the item RA.

Message 1.1.1.1.3 switches to RA and displays it. At this time the NB contains only the item CA₁.

Message 1.1.1.1.3.1 triggers CA₃ and displays it. Then the NB contains only the items RA and CA₁.

The exit command on CA₃ switches automatically to the last started application, in this case CA₁.

The exit command on CA₁ switches automatically to the last A started, in this case RA.

Applications based on Java ME are portable across many devices, yet leverage each device's native capabilities and from a market analysis conducted in Giunti Labs, it is clear that the most of the devices support J2ME technology.

Figure 6 displays clearly the architecture of the eXact GEO system: it is possible to identify two main components, the client side on the mobile and the server side.

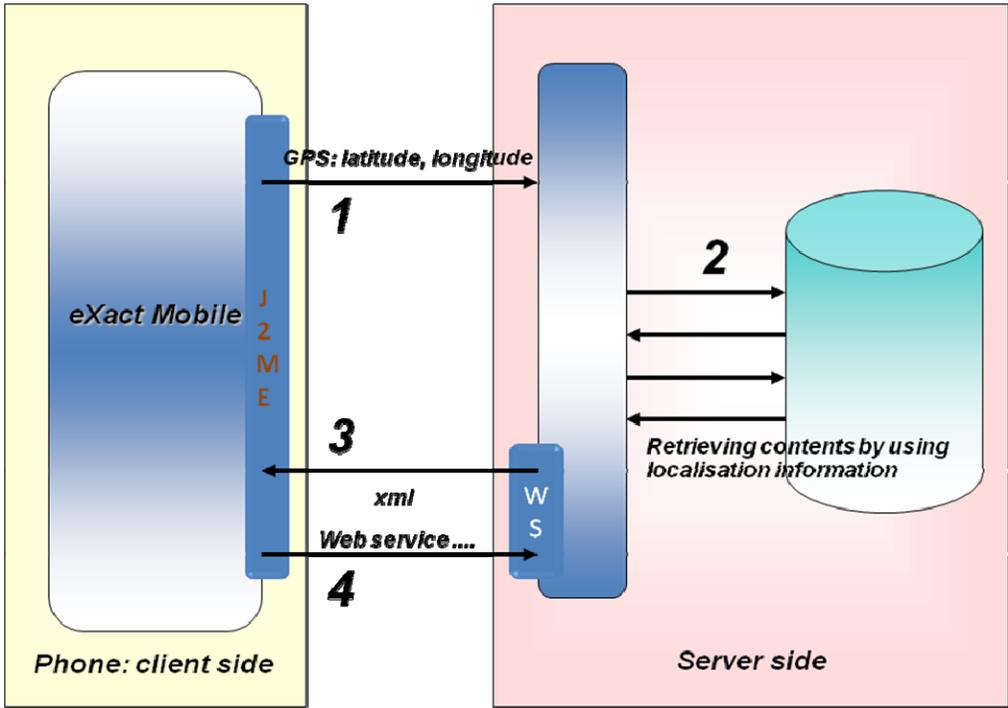


Figure 6 – eXact GEO.

In order to make eXact GEO work on the mobile devices, it is necessary that the following Java Service Requests (JSR) are supported by the given device:

- *JSR82 - Bluetooth API:* It enables searching for Bluetooth devices, querying device profiles and capabilities and opening stream connection to device.
- *JSR118 - Mobile Information Device Profile 2.0:* The Mobile Information Device Profile (MIDP), when combined with the Connected Limited Device Configuration (CLDC), is the Java runtime environment for today's most popular compact mobile information devices, such as cell phones and mainstream PDAs.
- *JSR135 - Mobile Media API:* It defines the Multimedia API for the Java™ 2 Platform, Micro Edition (J2ME™).
- *JSR139 - Connected Limited Device Configuration 1.1:* The Connected Limited Device Configuration (CLDC) defines the base set of application programming interfaces and a virtual machine for resource-constrained devices like mobile phones,

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paggers, and mainstream personal digital assistants. When coupled with a profile such as the Mobile Information Device Profile (MIDP), it provides a solid Java platform for developing applications to run on devices with limited memory, processing power, and graphical capabilities.

- *JSR172 - J2ME Web Services Specification*: The purpose of this specification is to define an optional package that provides standard access from J2ME™ to web services.

Technical Note:

Supported formats:

- Image formats PNG, JPG
- Audio formats midi, mp3(if supported by device), amr
- Video formats AVI(if supported by device), MPG(if supported by device), 3GP.

Client side Requirements

The following list displays the requirements necessary for the client software to be installed on the mobile device:

- eXact GEO is a CA and is not based on IMS technology.
- eXact GEO is composed of a Portal Application (PA), a Set-up Application (SA), a Login Application (LA), a Engine Application (EA) and a Browser Application (BA).
- PA is the portal of SA and LA.
 - PA allows loading only an application per time.
- SA allows setting the default Global Positioning System (GPS) Bluetooth device.
 - SA allows moving back to PA.
 - SA allows closing eXact GEO.
- LA allows to login to NO IMS.
 - If the username and password are right, LA allows loading EA.
 - If the username or password is wrong, LA does not allow loading EA.
 - LA allows moving back to PA.
 - LA allows closing eXact GEO.
- EA uses the default GPS Bluetooth device.
- EA downloads the list of contents related to the geo coordinates.
 - EA allows stopping of the download of the list of contents.

- EA allows switching the list of contents to map and vice versa.
- EA allows moving back to LA.
- EA allows closing eXactGEO.
- If the list of contents is displayed, EA allows choosing content.
- If the map is displayed, EA shows the position of the user and the icons of the contents on the map.
 - If content has been selected, EA checks if the content has just been downloaded or not.
 - If the content has just been downloaded, BA displays it.
 - If the content hasn't been downloaded, EA downloads the content and BA displays it.
 - EA allows stopping of the download of the content.
 - EA allows moving back to the list of contents/map.
 - EA allows closing eXact GEO.
- BA allows navigation of the content.
 - If the content contains a self assessment test, BA is able to send the result to NO IMS.
 - BA allows moving back to the list of contents/map.
 - BA allows closing eXact GEO.

Server side Requirements

The following list displays the requirements necessary for the software to be installed on the server side:

- The Server side is represented by learn eXact, a Learning Content Management System (LCMS) that allows to create, index, store, revise and manage eLearning and Mobile Learning content. As a LCMS, it has got an XML database.
- The Server side offers specific web services to eXact GEO.
 - GetListContents(session token, x , y , r): get the list of contents. In case of successful session token, x y geo coordinates, and max distance r of the contents from the user, it will return a list of item (session token, ID, Name, x , y , Version).
 - GetContent(session token, ID): get the content. In case of successful session token and ID, it will return the content.

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- The Server side offers standard learn eXact web services to eXact GEO.

eXact GEO Use case

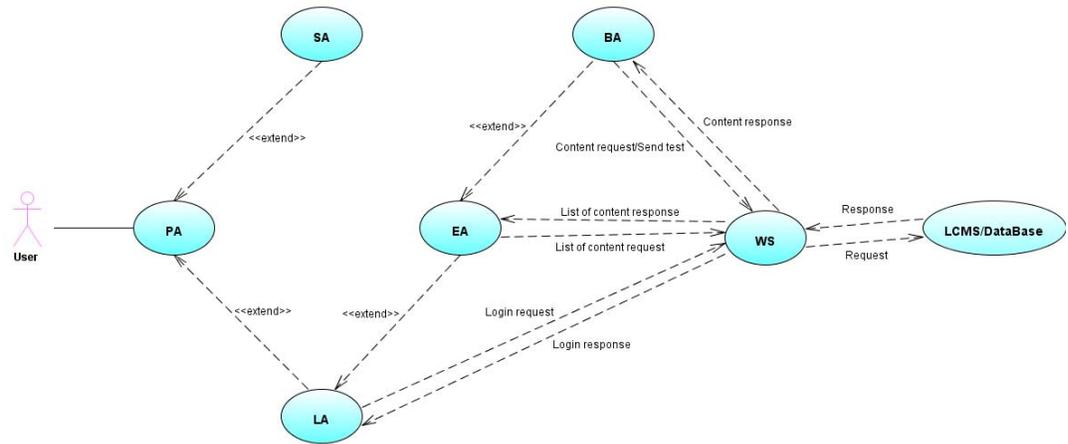


Figure 7 – eXact GEO Use Case.

Figure 7 represents the eXact GEO from the perspective of the users of the system.

The actor User is a human.

The use case Portal Application (PA) is the main activity that eXact GEO performs for the User.

The use case Set-up Application (SA) is the activity that eXact GEO performs to set the default GPS Bluetooth device.

The use case Login Application (LA) is the activity that eXact GEO performs to login to the Server Side (LCMS). The login uses the Authenticate web service of learn eXact LCMS.

The use case Engine Application (EA) is the activity that eXact GEO performs to download the list of contents from the learn eXact LCMS.

The use case Browser Application (BA) is the activity that eXact GEO performs to download and browse the content and to send possible self assessment test to the LCMS. The downloading feature uses the GetListContents web service of LCMS.

The use cases BA is the activity that eXact GEO performs to download and browse the content and to send self assessment test results. The downloading feature uses the GetContent web service of the LCMS The send self assessment test uses the GetTest web service of the LCMS.

eXact GEO State Diagram

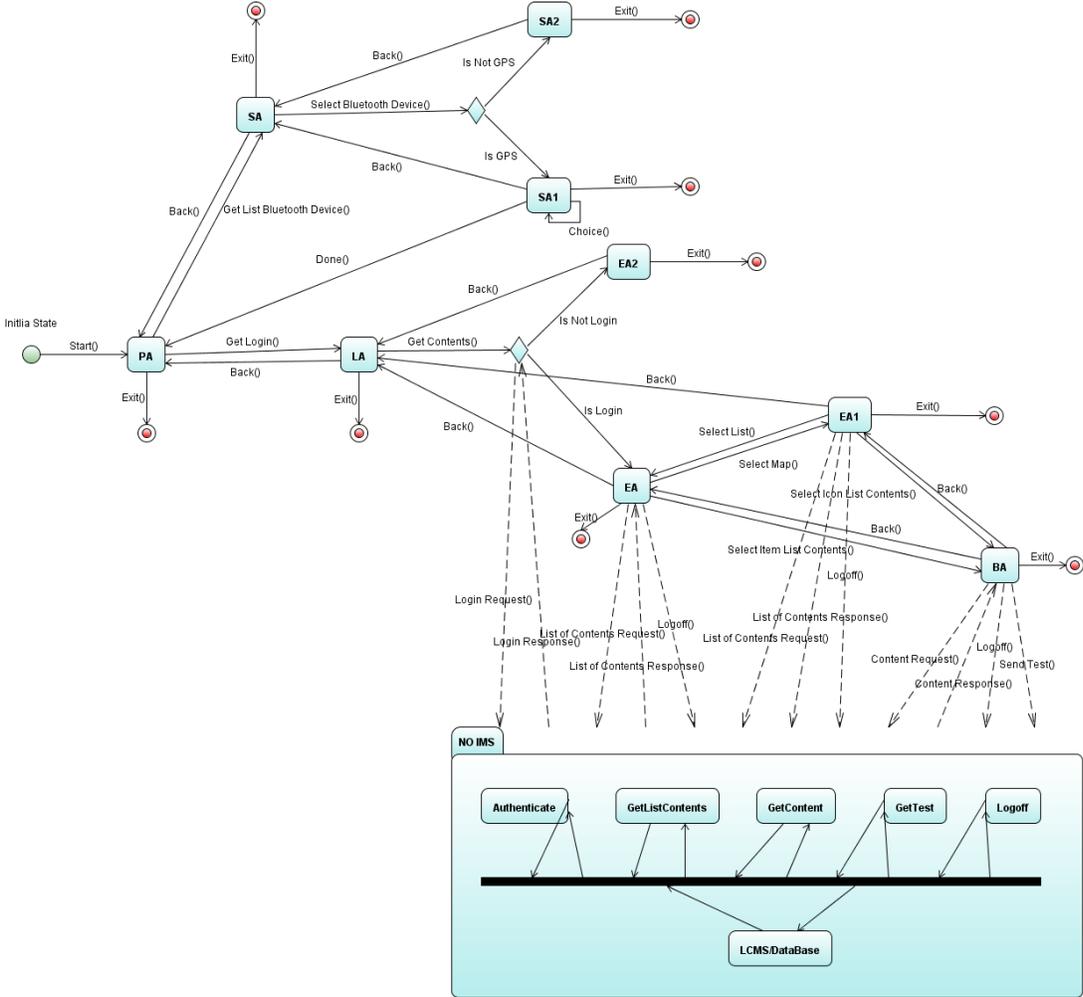


Figure 8 – eXact GEO State Diagram.

Figure 8 represents the states and responses and internal triggers. eXact GEO is composed of eleven states: Initial State, PA, SA, SA₁, SA₂, LA, EA, EA₁, EA₂, BA and a Final State. eXact GEO is based on a GUI. LCMS is composed of five states: Authenticate, GetListContents, GetContent, GetTest, Logoff, and LCMS/DataBase.

- Initial State:
 - Start(): allows starting eXact GEO.

- Portal Application (PA):
 - Get List Bluetooth Device(): the click on **buttonSetting** allows finding the list of Bluetooth devices and switching on SA.

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- **Get Login()**: the click on **buttonStart** allows login only if the default GPS device is set.
- **Exit()**: the click on **commandExit** allows exiting from eXact GEO.
- First state of Set-up Application (SA): the GPS device has still to be selected
 - **Select Bluetooth Device()**: the click on an item of the list of the Bluetooth found devices, allows testing GPS device. If there is a valid GPS device, it is possible to select the default Bluetooth device and switch to SA₁. If there is not any valid GPS device, “GPS not found” message will be displayed and there will be the switch to SA₂.
 - **Back()**: the click on **commandBack** allows moving back to PA.
 - **Exit()**: the click on **commandExit** allows exiting from eXact GEO.
- Second state of Set-up Application (SA₁): the GPS device is available
 - **Choice()**: the click on an item of the list of the GPS Bluetooth device found, allows choosing the default GPS device.
 - **Done()**: the click on **commandDone** allows coming back to PA.
 - **Exit()**: the click on **commandExit** allows exiting from eXact GEO.
- Third state of Set-up Application (SA₂): no valid GPS device
 - **Back()**: the click on **commandBack** allows coming back to SA.
 - **Exit()**: the click on **commandExit** allows exiting from eXact GEO.
- Login Application (LA):
 - **Get Contents()**: the click on **buttonLogin** allows login to LCMS. **Login Request()** is sent to Authenticate web service. If **Login Response()** is **login**:
 - **List of Contents Request()**, is sent to **GetListContents** web service, allows downloading list of contents.
 - **List of Contents Response()**, is got from **GetListContents** web service, allows switching on EA.
 - If **Login Response()** is **not login** allows switching on EA1 and displaying a message “Username or Password wrong”.
 - **Back()**: the click on **commandBack** allows moving back to PA.
 - **Exit()**: the click on **commandExit** allows exiting from eXact GEO and LCMS **Logoff()**.

- First State of Engine Application (EA): successful authentication and the list of the contents is available
 - [Select Item List Contents\(\)](#): the click on an item of the list of contents, allows switching on BA and browse the selected content.
 - [Content Request\(\)](#) is sent to [GetContent](#) web service, allows downloading the content.
 - [Content Response\(\)](#) is got from [GetContent web service](#), allows switching on BA.
 - [Select Map\(\)](#): the click on [commandMap](#) allows switching to EA₁.
 - [Back\(\)](#): the click on [commandBack](#) allows moving back to LA.
 - [Exit\(\)](#): the click on [commandExit](#) allows exiting from eXact GEO and LCMS [Logoff\(\)](#).
- Second State of Engine Application (EA₁): successful authentication and the contents are displayed on a map
 - [Select Icon List Contents\(\)](#): the click on an icon of the set of contents, allows switching on BA and browse the selected content.
 - [Content Request\(\)](#) is sent to [GetContent](#) web service, allows downloading the content.
 - [Content Response\(\)](#) is got from [GetContent](#) web service, allows switching on BA.
 - [Select List\(\)](#):the click on [commandList](#) allows switching to EA.
 - [Back\(\)](#): the click on [commandBack](#) allows moving back to LA.
 - [Exit\(\)](#): the click on [commandExit](#) allows exiting from eXact GEO and LCMS [Logoff\(\)](#).
- Third State of Engine Application (EA₂): unsuccessful authentication
 - [Back\(\)](#): the click on [commandBack](#) allows moving back to LA.
 - [Exit\(\)](#): the click on [commandExit](#) allows exiting from eXact GEO.
- Browser Application (BA):
 - [Send Test\(\)](#):If the content contains a self assessment test, the results are sent to the LCMS.

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- **Back()**: the click on `commandBack` allows moving back to EA or EA₁.
- **Exit()**: the click on `commandExit` allows exiting from eXactGEO and LCMS `Logoff()`.

eXact GEO Installation Steps

The following outlines the steps to be taken to install eXact GEO on a mobile device

- Connect the mobile device to the computer.
- Access or create a folder on the mobile device and copy over the .jad and .jar files.
- On the mobile device access the folder where the two files have been copied
- Select the .jad file and start the installation
- Select eXact GEO to start the application.

Conclusion

The technology and development environment that the partners are using during phase 1 of course development are still being refined and developed. Consequently, a major aim of the partnership is to ensure that all outputs are reusable and transferable. As a result, course content development during this phase of the project will be portable to an IMS enabled environment in the later stages of the project pending commercial availability of IMS networks.