Collaborative development of a ubiquitous elearning environment for cross platform delivery

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Abstract
We describe the development process for an authoring and delivery environment for ubiquitous elearning currently under development in the context of an EU FP6 project[1]. The early requirements - gathering stage of the project used a distributed scenario-based method, inviting participatory idea generation from designers and potential users in nine partner countries. We present a number of the scenarios that resulted from this process, enabling the derivation of requirements for the overall architecture for the system. Finally, we discuss current and future directions for the project.

Introduction
Ubiquitous technologies can provide great opportunities for learning (van 't Hooft & Swan, 2007). Learning in this way should not tie learners to specific places, times and situations as it is delivered through existing technologies already in use in the context of learners' day-to-day activities. In particular, new "non-desktop" technologies, including interactive television and mobile devices have great potential for supporting ubiquitous learning (Atwere & Bates, 2003; Fallahkhair et al., 2007; Naismith et al., 2005). Researchers and practitioners worldwide are working together towards developing more sustainable pedagogical and practical solutions in delivering this new paradigm of learning (Sharples, 2006). In this paper we discuss the development process of an authoring and delivery environment for ubiquitous elearning currently under development in the context of LOGOS, a multi-partner European FP6 research and development project (Pemberton et al., 2007).

The major aim of the LOGOS project is to provide ubiquitous access to e-learning materials via digital video broadcasting (DVB), mobile and IP-based communication channels. Like many large European projects, it involves multiple countries and partners; in this case, fifteen partners from nine different countries are pooling their different skills, knowledge and interests. This presents a number of challenges for development, not only at the managerial level but also at every stage from early requirement gathering to design, development and evaluation. In this paper, we concentrate on the scenario-based method that was employed to gather early requirements to direct the development process.

In the following section we discuss the scenario based design methodology that we adopted and present five of the several scenarios developed by the project, including what we have called the "abstract scenario".

Methodology
Scenarios are used in systems design to describe typical or important uses of the system as narratives or stories (Carroll, 2000). They are designed to give designers, developers, users and managers a shared understanding of the purpose of the system and the ways it will be of use in practice (Fallahkhair et al., 2004). Developing this common understanding was particularly important in the LOGOS project, given its many partners, all with different backgrounds and understandings. There are a number of different interpretations of the term scenario and a range of

[1] LOGOS: FP6-2004-IST-4

different approaches to developing them. One reasonable approach is to take some general requirements, informed by theory, and to have developers generate usage scenarios on that basis. The general requirements for the LOGOS system, informed by work in andragogy, elearning and informal learning, were to generate an authoring system for cross platform learning materials and a delivery mechanism to presentation of these materials to learners. Potential users form another valuable source of inspiration for scenarios, and in the LOGOS project we decided to take advantage of the availability of such potential users to develop our scenarios from user input and have any developer-generated scenarios validated by user feedback (Taylor & Evans, 2004).

The stages in the development of the LOGOS scenarios were as follows:

1. Example scenarios by the fifteen LOGOS partners based on the resources they each had available for exploitation and the technologies and contexts they were able to support. The emphasis was broadly on the domains of cultural heritage, basic skills and business studies, but other domains were also explored.

2. A first scenario workshop was held at each partner site, each with one homogeneous group of potential users (for instance, French Masters level sociology students, tourists visiting a UK seaside resort, Hungarian secondary school geography students, Slovakian year medical students practicing diagnosis, Finnish knowledge workers updating their language skills and so on). Learners were introduced to the media objects/archive materials the partners intended to use, plus the range of technologies on which they proposed to implement learning materials. Participants were encouraged - using role play and discussion, often incorporating lo-tech prototypes in paper, cardboard and so on, to imagine scenarios or stories in which they would use the materials for learning tasks of their own.

3. LOGOS partners refined and sifted the ideas generated at the first workshop to create a number of scenarios that combine the key points raised in the workshops.

4. A second scenario workshop was held at each site, with different individuals from same type of user group. The LOGOS team presented or acted out the scenarios and gathers users' feedback. LOGOS partners reflected on feedback and incorporated it into a second version of the scenarios.

The process followed the same basic structure across all partner sites, eliciting input from representative user types. The various project teams, from nine partner countries, generated future usage scenarios. In total, 26 scenarios were developed that would illustrate the use of the authoring and end delivery systems in as wide a range of combinations, subject areas and contexts as possible. Examples include learning cultural heritage, language learning, project management, teacher training and learning about Eastern Christian iconography.

It was necessary to develop a wide range of realistic scenarios in terms of topic, context, media and so on, in order to create a sound shared understanding of the proposed system. However, referring to a multiplicity of detailed scenarios runs the risk of obscuring commonalities in a welter of detail. Therefore, at this stage of the project, it became apparent that we needed to develop a generic scenario that we refer to as "abstract scenario" in order to give an "end to end" account of the authoring and reception processes, in a content-free way. The scenario includes all the tasks envisaged in the scenarios and engages authors and learners in a full range of roles, thus providing a good basis for further development of detailed technical requirements. The scenario begins at the end of the "supply chain", i.e. with the learner.

The following section presents a shortened version of four specific scenarios (learners and authoring scenarios) and the abstract scenario that was developed to encompass them.

Scenarios for ubiquitous e-learning

Learner scenarios demonstrate how learner will interact with LOGOS service, while the abstract scenario explores the phases necessary in creating and transmitting learning materials to learners. Together the scenarios serve as a source of requirements for developing the architecture of the LOGOS learning platform, described in the next section. There are different roles of people who are involved in this process, including: *Learner*, *Courseware*

developer, Learning designer, Educationalist, Indexer, and *Knowledge manager*, which are also made as Italic in the following scenarios.

Learner scenarios

Learner scenario 1: informal learner access web based information on historical site via smart phone
George (40) is in Brighton for the weekend with his daughter *Laura (12)*. They are looking for an activity that both will enjoy and decide, after seeing its web site (http://www.rth.org.uk/) to visit the Regency Town House, a restored building in one of the town's Georgian squares. They both quite enjoy the guided tour, but still have questions they want answered. *George* works in construction and is keenly interested in architecture. He is intrigued to hear from the tour guide that information about the house's architect, Charles Busby, is available digitally. *Laura* is much more interested in daily life in such a house. As they sit in the garden square after the visit enjoying fish and chips from a nearby shop, they each explore the material available to them on their 4G mobile phones. *George* navigates to an area about architecture where he is able to read through a digitized book by Busby. Via an email link he sends a question to the museum curator. *Laura* looks through drawings of children's dress in the Regency period. (these would ideally be annotated with speech, but text only is currently available). She sends these to her email account as she'd like to record her trip in her blog.

Learner scenario 2: novice elderly users browse enhanced broadcast television programme to learn local history
Molly and Cyril have lived in Brighton all their lives and are interested to see in the film of Brighton Rock that they're watching on BBC1 at the moment, some scenes of the town as they remember it from pre-war days. When it ends they hit the interactive button hoping that there will be some interesting supplementary material they can relate to. The system finds them a number of contemporary videos, one of the beach, where several scenes were filmed. They see that it's possible to browse through other topic, to jump to other related clips and to search using keywords, something they've never done before as they have no PC experience or interest. They want to see what else is available and follow links to a film of VE day celebrations, Remembrance Day celebrations. They type in the name of their area and view a film clip of the 1974 Golden Jubilee in their own street. This they save in the Home Media Disk to show their neighbours and family later.

Authoring scenarios

Authoring scenario 1: Creating a courseware object from scratch
Liisa is a Multimedia Producer in YLE Company, the public broadcaster in Finland. Her team has been assigned a task to create interactive enhancements to a TV series covering issues on health. Her team members have already been active in interviewing the experts visiting the episode under work. Together with the experts, they have prepared textual information packages that give a wider aspect to the issues covered in the episode. They have also crafted some simple questionnaires and tests. *Liisa* opens the LOGOS platform and the Learning Object Design tool. She imports all the relevant video clips and annotates them according to the ontologies present in the installation of the LOGOS platform, with the aid of a plug-in developed by YLE. She uses the design tool to construct the Learning Objects from the textual material, questionnaires, and audiovisual material. Some of the learning objects require special capabilities such as internet access to send data to a server, and email capabilities. The design tool helps *Liisa* to tag these learning objects accordingly. She then proceeds to store the learning objects to the repository. After that, *Liisa* constructs separate courseware objects for each of the target receivers, WWW, interactive TV, and mobile devices, selecting the relevant learning objects to each of the packages. She then sends the resulting courseware objects to a test team to be tested before publication.

Authoring scenario 2**: **importing existing content to LOGOS repository
YLE company have existing connections for other broadcasters (such as the BBC) with whom they produce series of educational TV programs. In addition, they also have a Multimedia Production team creating additional material enhancing the learning experience on a WWW-based system. Currently, YLE have produced with the BBC a series of learning basic Chinese, with the specific aim to make that available during the Olympic Games in Beijing on 2008. Their Multimedia Production team have made independent learning content for the WWW to enrich the learning experience.

Riitta is the manager of Multimedia Production Department in YLE. She wants to make the existing learning content available to a wider audience, including other receivers such as the mobile devices and the interactive digital TV receivers. *Riitta* starts with logging on to the WWW-based learning content management system. She selects the import function, and then proceeds to select the content from the WWW-based learning environment. The system asks whether she wants to map the existing metadata of the learning objects to the ones present in the LOGOS platform but she chooses to postpone that task until after the new learning content has been published. She is also requested to define a Digital Rights Management policy, and she selects from a pre-defined list the one that specifies that each of the learning objects can be accessed independently and free of charge, but the content can only be streamed from YLE servers and not stored permanently on the receivers nor redistributed. The system then asks her to select the target devices for the content. She selects pre-defined choices "Interactive TV" and "Mobile Device" and continues. *Riitta* uses an external tool developed by YLE to evaluate the required device capabilities for the learning modules. The tool outputs a warning for two of the learning objects, both of which include sending an email (which has been considered a capability not to be present on most interactive TV receivers by YLE). *Riitta* then takes a closer look at these learning objects. She verifies that neither one of the learning modules are mandatory for the learning experience, rather they merely offer additional support for the learner. After some consideration, she decides not to include those modules to the courseware object for interactive digital TV. Next, *Riitta* imports a layout template for mobile devices, designed by a graphical designer using a tool developed internally at YLE. She uses the LOGOS publishing tool to export the version for mobile devices. She passes the resulting courseware to a test team to be tested before the final publication. She then goes back to the LOGOS publishing tool, removes the two learning objects with the requirement for email capabilities, imports the pre-designed layout template for interactive digital TV and publishes another courseware set to be tested by a test team before publication.

On the basis of these and the remaining 22 scenarios, which each describe a phase of the authoring or learning process, we developed the following abstract scenario summarising the logical implications of the detailed scenarios.

Abstract scenario
Learner has registered for access to learning service. *Learner* may already, as part of the registration process, created a learner profile. *Learner* finds learning content by browsing through hierarchical collection of courseware and selects courseware element to view. *Learner* interacts with learning content by navigating through courseware. Search is also available within the learning environment. *Learner* makes textual annotations and also bookmarks interesting sections. Chat and discussion boards are also available to enable *learners* to interact with other *learners*. *Learners* can resume study of learning materials and access them from different device, e.g. iTV, mobile and PC.

Courseware developer can create new courseware file by selecting generic template or specialist presentation genre template. *Courseware developer* can import learning object (LO) from repository to create and edit courseware. *Courseware developer* can preview and publish courseware for different device to be delivered, e.g. iTV, mobile and PC.

Learning designer can create learning designs (abstract training scenarios) used for the automatic creation of personalized learning experiences. *Learning designer* can create, browse, view, and edit new learning design.

Educationalist can create new learning object (e.g. picture, video, text). *Educationalist* can browse, import edit, annotate and save digital object.

Indexer can import and annotate raw material from external source (e.g. audio-visual materials) to be used by educationalist.

Knowledge manager can set up domain ontology by creating and defining nodes (concepts) and links (relations) for the domain. Knowledge manager can also edit nodes and links.

Ubiquitous e-learning platform
From the scenarios above it can be seen that the development of ubiquitous learning in LOGOS is dependant on a number of roles linked to different tasks to move through the phases of the authoring and learning processes. This

leads to the development of an overall architecture for the project. The details of the technical development architecture are discussed elsewhere (Arapi et al., 2007): here we provide an overall non-technical picture of the authoring and delivery systems, that including all the roles involved and the technologies used. Figure 1 demonstrates this overall picture and interactions between these different roles and technologies.

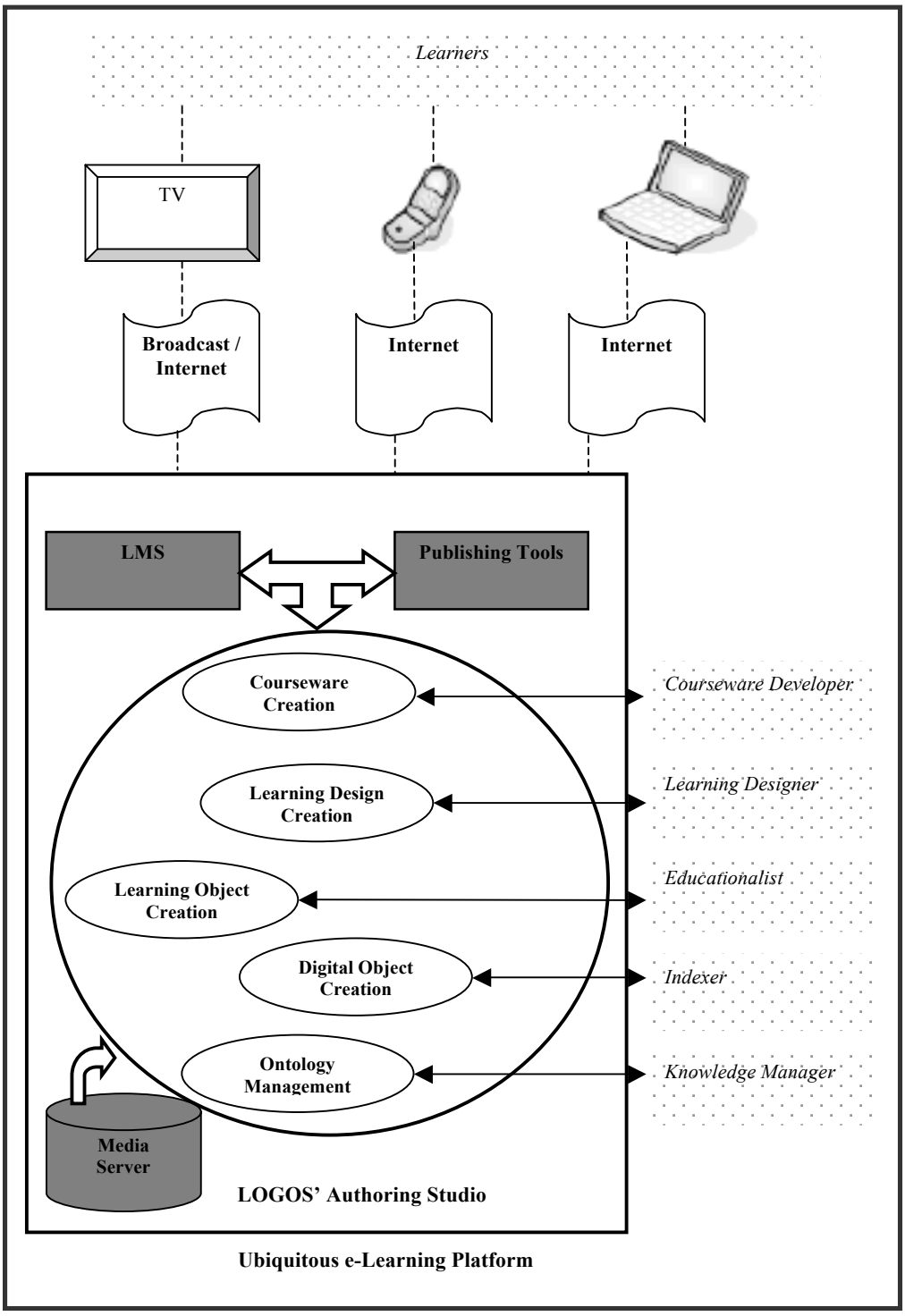

Figure 1: Ubiquitous e-Learning Platform

Conclusions and further work

In this paper we have briefly described the use of scenarios to manage the distributed collaborative early requirement gathering stage of the LOGOS project. The overall architecture of the ubiquitous e-learning platform was developed on the basis of the scenarios and is currently close to complete implementation. This will present two main areas for further research. A first set of issues concerns the methodology for evaluating the ubiquitous e-learning authoring and delivery platform. At the moment we are considering evaluating the system in terms of its usability but will need to develop new techniques tailored to the cross platform scenarios that were presented here (Pemberton & Fallahkhair, 2006). A second set of issues relates to the development of sound business models that could be used for future adaptation and integration of the LOGOS system by e-learning providers and learners.

References

Arapi, P., Moumoutzis, N., Mylonakis, M., & Christodoulakis, M. (2007). Pedagogy-driven personalization framework to support adaptive learning experiences. *Proceedings of ICALT 2007,* Niigata, Japan

Atwere, D., & Bates, P. (2003). Interactive TV: a learning platform with potential. *LSDA Publication.*

Carroll, J.M. (2000). Five reason for scenario-based design. *Interacting with computers*, 12, pp. 43-60

Fallahkhair, S., Pemberton, L., & Masthoff, J. (2004). A dual device scenario for informal language learning: interactive television meets the mobile phone. *Proceedings of ICALT 2004,* Joensuu, Finland.

Fallahkhair, S., Pemberton, L., & Griffiths, R., (2007). Development of a cross-platform ubiquitous language learning service via mobile phone and interactive television. *Journal of Computer Assisted Learning*, 23, pp. 312-325.

Naismith, L., Lonsdale, P., Vavoula, G., & Sharples, M. (2005). *Literature review in mobile technologies and learning*. Nesta Futurelab.

Pemberton, L., & Fallahkhair, S. (2006). Beyond usability: evaluating a cross-platform language learning service for iTV and mobile phone, *Proceedings of EuroiTV 2006*. Athens, Greece.

Pemberton, L., Fallahkhair, S., Griffiths, R., Kanerva, M., & Fehér, G. (2007). Combining learning affordances in cross platform learning environment, *Proceedings of EDEN 2007*. Budapest, Hungry.

Sharples, M. (2006). Big issues in mobile learning: report of a workshop by the Kaleidoscope network of excellence mobile learning initiative. University of Nottingham.

Evans, D. & Taylor, J. (2004). The role of user scenarios as the central piece of the development jigsaw puzzle. *Proceedings of mLearn 2004*, Bracciano, Rome.

van ‘t Hooft, M. & Swan, K. (2007). *Ubiquitous computing in education: Invisible technology visible impact*. London: Lawrence Erlbaum Associates Publisher.