

A UML DEFINITION OF A MANAGEMENT FRAMEWORK FOR E-LEARNING SESSION-CENTRIC SERVICES

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Abstract: During the last decade, systems offering various e-learning services are implemented en masse. Proposed management framework aims at acting as a facilitator among e-learning systems, learners, underlying communication infrastructure and access devices, content and delivery methods, forming an integration management middleware, while at the same time acts as a broker for e-learning and content providing systems. Our framework is session profile centric, since a key characteristic is the dynamic creation of user session by detecting and managing information and parameters that are either derived by stored profiles or change dynamically at each user session. In this paper, we present content and e-learning provision services' context, along with the proposed architecture overview. We also present session profile and a UML definition of its creation process.

1 INTRODUCTION

Since electronic services have emerged as the new popular trend in service provision area, education market has shifted towards electronic learning in a view to offer alternative and flexible services. Technology has offered consumers capability to acquire access to e-services provision from anywhere. However, users are not always experienced in using electronic environments. Consequently, research focuses on offering personalized services to users according to their profile, preferences or context. Designing and implementing an e-learning service is a complicated process, since there are many factors that define the service. With a view to manage such a service, we propose an e-learning services management framework, which also offers brokerage services to content/e-learning providers (Apostolopoulos and Kefala, 2003b). A core element of the management framework is the dynamic creation and management of user session, according to diverse parameters and information that are either static or change dynamically per session. In sections 2 and 3, we present context analysis and related work in the area of e-learning/content services, along with an architectural overview of proposed management framework. In

section 4, we analyse user session profile and give a formal description of session profile creation using a UML diagram.

2 CONTEXT REVIEW

Content Management Systems mainly focus on content creation, management, delivery and contracting with customers (Robertson, 2002). Learning Content Management Systems (LCMS) concentrate on managing learning content at learning object granularity (Wan et al., 2005). Learning Management Systems are usually focusing on learner management, progress tracking (Akpinar et al., 2004), facilitation of learner-tutor interactions (Redol et al., 2003) and management of administration issues. Learning Resource Brokers usually implement functions, such as: browsing and searching of resources, displaying metadata concerning these resources and managing of resources delivery (Retalis et al., 2004). Consumers can now enjoy e-content and e-learning services from home, connected through narrowband technologies, from work, from a university campus having broadband connectivity, or while being on the road via some mobile network, deploying diverse devices such as desktop computers or

laptops, PDAs or cellular phones.

Context awareness is lately designated as a key parameter for adaptive e-services. In (Keidl and Kemper, 2004), they present a context framework that facilitates the development and deployment of context-aware adaptable web services and they include consumer's identification details, type of device, location, communication and format as context elements. In (Handorean et al., 2005), they introduce a context aware "follow-me sessions" management architecture within an ad hoc networking environment, where a client is allowed to switch service provider when needed.

As depicted in (Broens et al., 2004), the "Cooltown" project allows users to discover services that are in user's vicinity and the "Context Toolkit" provides functionality to discover services using contextual information, allowing for the description of services by means of white and yellow pages. In the same paper, they present an approach for service discovery that uses ontologies to capture the semantics of user's query, of services and contextual information that is considered relevant in the matching process. In (Yang, 2006), they propose a context aware ubiquitous learning environment consisting of a peer-to-peer content access and adaptation system, a personalized annotation management system and a multimedia real-time group discussion system. Some systems offer e-learning service adapted to students learning style identified by their abilities, learning attitudes and preferred ways of study (Park, 2005), and are based on a model which expresses goals, preferences, and knowledge of individual users (Lee and Chong, 2002).

Most implemented content/e-learning provision platforms are not flexible enough to meet dynamically altering context and connection characteristics, while even the more sophisticated ones, usually support either personalization of content according to user profile, or emphasize user-service vicinity factor, but still do not take into account all parameters that might differentiate from session to session. Therefore, we have noted the lack of a Content and e-Learning Provision Services Management Framework that would manage all diverse aspects of such services and would act as a broker among content and e-learning providers and users (Apostolopoulos and Kefala, 2003a).

3 ARCHITECTURAL OVERVIEW

Proposed e-Learning Services Management Architecture is based on a middleware concept, considering an intermediate layer between some e-learning providing

application and the underlying communication infrastructure (Apostolopoulos and Kefala, 2003b). Proposed framework offers a management scheme for e-learning services provision by gathering and managing various information and metadata concerning all involved stakeholders, systems and infrastructure. In order to support architectural simplicity, flexibility and adaptability, we have chosen a component oriented design approach. Proposed e-learning service management framework is based on a three-layer architecture. The lower one concerns management of network infrastructure, including communication protocols, as well as management of access device characteristics. The upper layer of proposed architecture is occupied by some e-learning/content providing system. Depending on functionality supported by these systems, middleware undertakes a more or less active role, acting only as a broker or providing complete management service. The intermediate layer concerns the proposed management middleware.

While analyzing layered architecture, different components are defined, which deal with implementing specific functionality. Each component manages a set of information concerning offered services and actors interacting with middleware. The main component (*Service Management Component*) is the one that dynamically creates and manages a session profile, taking into account various parameters in order to offer adequate quality of service (Apostolopoulos and Kefala, 2004). These parameters are managed by different components of the middleware in a view to meet requirements for flexibility and implementation simplicity. This component undertakes the role of service manager and is also responsible for coordinating components' interaction. Service Manager either creates a new user session or rejects user request in case that service prerequisites are not satisfied. This component manages all required information so that at any given moment, an overall snapshot of system status can be retrieved and formed (active sessions, service availability, resources availability, number of served users, etc.).

Since a key requirement is offering same kind of services to users accessing broker services via diverse devices and connection types, availability of different content versions is an important issue. When, for example, a user -using a low bandwidth and limited presentation capabilities mobile phone- requires content, broker should select a version of the content that would not be so fancy or resource demanding, whereas to a user on a personal computer at a university campus, broker could provide a different version of the "same" content that would be more resource-consuming.

4 SESSION PROFILE

Since learner might access service from different environments in terms of network connectivity and devices, our management framework emphasizes on detecting user's current context characteristics in order to decide on accepting user's request and form specific session's profile. In order to create session profile, not only current user environment parameters are taken into account, but also current system's network conditions, availability of learning methods and communication protocols, as well as service providers resources availability and capacity.

Information that defines a session profile, includes data that are static and are derived from stored profile of system entities, as well as dynamic ones that might vary per session and are gathered on real time terms. Session profile covers the following axes:

- *User request parameters* (dynamic). It comprises user identification parameters and requested service identification elements.
- *Stored user profile* (static). It comprises information concerning identification elements, personal information, regional and language settings, user background, history of interactions with broker, user preferences, security information and payment methods.
- *User SLA* (static/dynamic). User Service Level Agreement (SLA) is some kind of a contract between user and broker, that defines the type and level of provided services. SLA is related to Quality of Service (QoS), which contains various constraints and requirements, in terms of network bandwidth and response time parameters, reliability, availability and cost.
- *User current context* (dynamic). Information describing current user context and concern her current location, time, access device capabilities, type of network connection and its characteristics and limitations.
- *Brokerage and management service context* (dynamic). This information mainly concerns broker resources availability and overall system status. Communication network's condition during the time the request for connection is issued (network load, available bandwidth, etc.) combined with the potential load introduced by the new connection is included.
- *Service context* (dynamic). Service context includes service profile, networks and protocols for service binding, devices and platforms for service execution, availability and status of involved providers.

4.1 Session Profile Creation Using UML Sequence Diagram

In the following paragraphs, we outline session profile creation process, which is also depicted in Figure 1, as a UML sequence diagram. Presented sequence diagram aims at capturing the behavior of system during session creation phase. This diagram describes interaction and collaboration between actors and system components in terms of messages passed between them in a sequential order.

As soon as a new request for service arrives at broker, several component agents are triggered in order to manage and serve user. Request is initially administered by the *Security sub-Component*, which is responsible for deciding whether the user is a registered and authorized one. User passes through some authentication procedure, depending on the security policy implemented. As soon as a user is successfully authenticated, her request is further processed to *Service Management Component* and more specifically to Session Manager, while *Learners Profile Management Agent* retrieves learner's stored profile along with user's Service Contract information. *Session Manager* is responsible for approving, initiating and managing a new session in order to serve the request. In order to decide whether the new request is served or rejected, it needs to concentrate all required information either static or dynamic.

Network and device agents are activated in order to detect current network status of user's connection, deployed network technology and access device characteristics on one hand, network availability and load of service providers on the other. *Content Service Provision Methods Management Agent* is responsible for providing information related to the types and methods of e-learning process currently available for the specific user, according to her contract and current status of e-learning service. At the same time, *Content Management Agent* decides on the types of learning content that can be provided to user according to her current connectivity status and Service Contract. In case that different versions of "same" content are available, appropriate version in order to provide quality of service, is chosen. At that point, *Session Manager* has gathered all necessary information to decide whether user request can be served adequately, according to user's Service Contract or not. Decision is based on combining all available information. In case that request can be adequately served, a session with user is initiated by activating an agent managing and monitoring specific session. Simultaneously, Logging-Accounting sub-Component triggers accounting procedure.

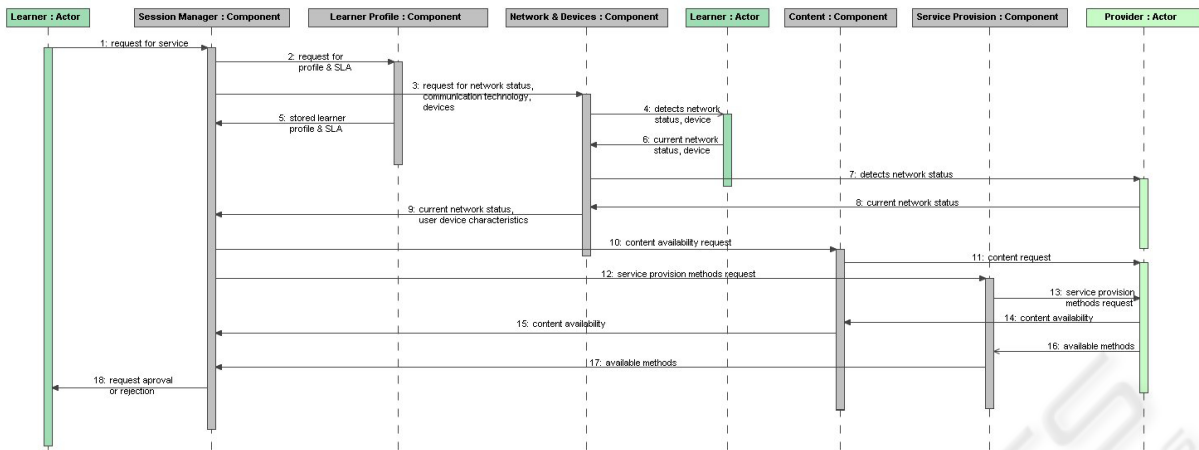


Figure 1: Session Profile Creation.

5 CONCLUSION

The proposed management framework presents a brokerage scheme for diverse content and e-learning providing systems, offering a common interface and service management context to users. The management framework is designed on a session-centric approach. Session profile is created dynamically, taking into account several parameters and context information - either static or dynamic- that might vary from session to session, in a view to ensure quality of service for users. Proposed framework can be deployed not only within e-content and e-learning service domain, but within e-services provision market in general.

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