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Review Paper

The Realization of Personalized E-Learning platform based on 3G Mobile phone and NGN control frame work for SIP based IP Networks

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Abstract

NGN core flexibility, its subject to adoption and the rapid growth in the personal mobile devices led to rapid growth in mobile based services as mobile E- Learning. The personalized E-Learning service is proposed based on J2ME , it is integrated with open source IMS control frame work for user management, session establishment using SIP protocol and Multimedia learning content delivery like voice, video, whiteboard sharing using RTP and RTSP. The proposed E-Learning platform comprises on four layers user agent layer (3G mobile phone, J2ME based SIP learning and teaching agent application software), access layer (3G UMTS, Wi-Fi, GPRS), Data communication layer (SIP signaling, XML data exchange between mobile client and Application server) and E- Control and Management layer (IMS control functions, HSS, Learning content application servers). This personalized E-Learning provides opportunity for learners and teachers to learn, teach and control management everywhere.

Keywords: e-learning2.0, J2ME, IMS, SIP, 3G.

Introduction

With the combination of Internet, multimedia and network technologies, E-learning is capable to change typical teaching using its methodologies[1,2,3]. The current and future mobile communication technologies are able to provide high bandwidth which ultimately change the people's life in many aspects as way of communication, teaching and learning, commerce, banking, gamming etc. Specifically, the rapid development in mobile phones and communication medium, enables teachers and student to teach and learn any where[4]. Therefore with the expansion of mobile development, mobile computing and internet technologies, in future smart learning would be the hot research topic and research would be required in maturity of distance education technology[5]. The flexible frame work of Next Generation Network open source core and development of E-Learning personalized services has been tended to be more and more popular in recent years[6,7]. To improve E-Learning service flexibility, scalability, understandability, Interactivity, availability and efficiency, a kind of personalized service have become very important in the research of E-Learning service[8]. The traditional form of E-Learning is web based programs and such kind of E-Learning systems and material without notion of pedagogy are tedious. Also with such systems the interaction of student and teacher, and learning understandability to student is terrible[9,10]. To overcome these constraints the appearance and growth of Web2.0 has brought up the idea of E-Learning 2.0 in which learner interactivity with tutor has been adopted[11,12]. Using Web2.0 technologies like Blog, RSS, SNS and IM in client side mobile application software allows learners to customize learning contents and learning environment[13,14].

Providing interactivity and multimedia E-Learning service on mobile phone, it is important to analyze mobile device data transmission rate. The speed of information transformation of 2.5G cell phone is only at the rate of 30kbps whereas in 3G cell phone information transformation rate is 384kbps. Therefore 3G cell phone is very proper for implementing client side learning and teaching agent[15,16].

The purpose of this document is to design a personalized E-Learning platform. In the proposed platform the realization of the integration of E-Learning 2.0 features, Web2.0 Features and NGN control framework is investigated, to launch it as value added E-Learning service. The paper also includes the development of user agent layer as SIP mobile client using SIP API JSR 180[17,18,19] which is available in J2ME[20] and the development of E-Control and Management layer.

Existing work related to mobile learning platforms

In the literature it has been seen that there are many educational and research organizations which are being involved in development of distance learning systems. Some of the organizations are Carnegie Mellon University, Best friend, Vaxjo School of Norwegian , Stanford School, UC Berkley, School of Manchester, CATD, NKI, Future Lab, Peking University , Nanjing University etc. In china Chinese suppliers customized E-Learning system PESMA was also suggested in 2006. In USA there are a lot of organizations which are involved in developing mobile learning systems. It has been seen that several E-Learning sites and Open source Learning

management soft wares have been constructed but the examination indicates that, the usage of such sites and software applications are not sufficient to attract active involvement of learners[21,22]. Therefore, how to use information technology utilities to solve pedagogical problems in e-learning, has become more urgent which could enable learners and teachers, to feel confident in E-Learning environment. According to the firm market research ABIR indicates that the focus on mobile learning would be increased in near future due to increase in 3G mobile users.

On the bases of above analysis and NGN open source core[6] availability a personalized E-Learning service is proposed which is integration of E-Learning 2.0 features, Web2.0 Features and NGN control framework to launch it as value added E-Learning service. The remainder of paper focuses on proposed user agent layer for development of SIP mobile client using SIP API JSR 180 S in J2ME and E-Control and Management layer using open source features of SIP Express Router SER. The prototype implementation of personalized E-Learning service is also realized.

System Design

A personalized E- Learning platform is illustrated in figure 1. It is mainly composed of four layers the user agent layer, access layer, data communication layer and E-Control and Management layer.

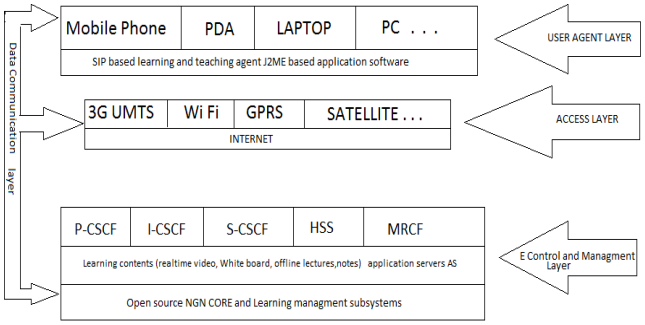

Figure-1
Layered Design of E-Learning platform

The realization process is as fallows: The E-Core which is stated as E-Control and Management layer includes open source SER[6] for IMS control functions, mysql for developing HSS, JAVA API JAX-WS for hosting E-Learning XML web services. The application software (learning and teaching SIP soft client) is packed through J2ME Wireless toolkit , compiled JAD document , and issued to the internet, so that user could download from internet to mobile terminal.

User agent layer: The user agent layer is composed of 3G or above mobile phone and SIP based learning and teaching agent. It provides interfacing to user of E-Service. The JAVA growing frame work J2ME for the development of mobile based application provides SIP API JSR180[15]. J2ME provides a group of API functions as MIDP (Mobile Information Device Profile), by using MIDP the user agent can be configured to communicate over internet using underlying IP connectivity and over SIP signaling with the E-Control and management layer[7,23,24]. As user agent interface provide privileges to user as shown in figure 6 and 7 to invoke any E- Learning service like real time video lectures, upload and download offline lectures, schedule, White board sharing, real-time question session and so on.

Teaching and Learning agent authorization and distinction: As E- Learning platform serves both teacher and learner. Teacher can use this to give lectures and take classes at any time and at any place using E-Learning user application software. The platform distinguishes between teacher and student using SIP ID based privileges mechanism illustrated in figure 2.

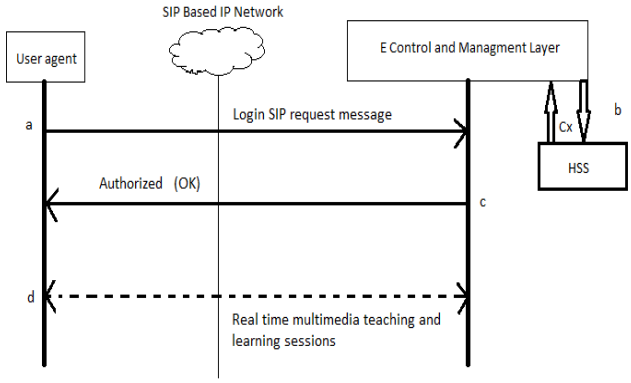

Figure-2
Agent authorization mechanism

In figure 2 HSS home subscriber server holds teacher and student related information. The purpose of this information is to allocate authorized E-Learning service resources according to SIP based separate ID's. For example if a teacher is going to login, will have ID like ajmal@teach.edu.pk and if the student is going to login , will have ID like ali@stud.edu.pk. In figure 2, where the scenario is elaborated using a,b,c,d passes, when any user whether teacher or student send SIP login request message to the P-CSCF , then it calls the HSS via the DIAMETER[25] Cx protocol stated in figure 2 and inquires whether the user is authorized to connect to E-Learning Web service. The I-CSCF calls the HSS via the the DIAMETER Cx protocol and inquires the respective S-CSCF to forward the message. Thereafter the S-CSCF calls the HSS and inquires the user profile and connects the user with the E-Learning Web service. Once a connection is established, user agent directly communicate with E-Learning application and management servers[26].

Data Communication Layer

Figure 3 describes the general network independency for a communication of student and teacher while learning and teaching. The session for teacher and student to invoke E-Learning application services like real time video lectures, white board content sharing, upload download lectures is initiated,

controlled and terminated by the SIP protocol [RFC 3261]. Multimedia data streams and payload of real-time applications are transported with the Real-Time transport Protoco[27,28]. The Real-Time Transport protocol RTCP is applied to observe Quality of Service (QoS) parameters[29]. The Real-time Streaming Protocol (RTSP) provides remote control of the media stream[30].

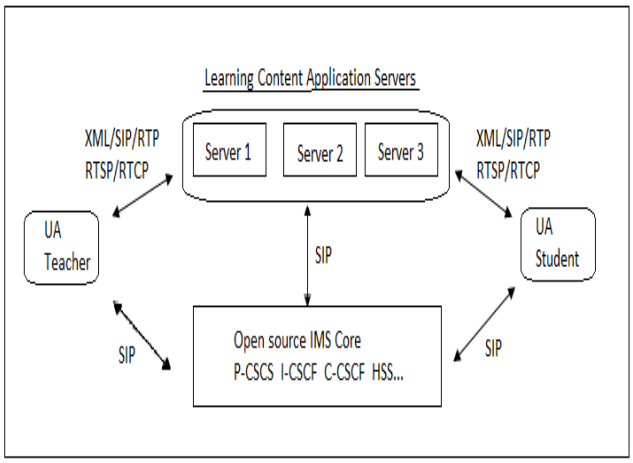

Figure-3
High level overview of Communication frame work of Personalized E-Learning platform

The server 1, server 2 and so on are the web servers which host E-Learning services. Any service like real-time video lecture of some subject is initiated from student user agent , when SIP request is received by IMS control function, SQL operation is performed in HSS for service subscription and service triggering and then SIP request is transformed to XML format which is then forward to real-time video lecture web server and session will be established between user agent and that web server. The realization of real-time video lectures and web servers will be discuss later. XML is a kind of special half structural data form, which can transmit many kinds of data information and separate description content. XML may carry transmission protocol of any text. It has the superiority of crossing system and platform.

Data transmission between Mobile terminal and E-Learning web server: The key of this platform is how to realize the connection and data exchange between mobile terminal and E-Core platform. SIP is an application layer signaling protocol , it establish session between two nodes, illustrating this scenario consider a mobile having learning application software like yahoo messenger and connected with E-Learning web server which is integrated with IMS control framework. A learner from his mobile, first "login" with the E-Core through SIP ID. When a learner is authorized and connected to the E-Learning platform, learner can invoke any service by clicking any of MIDLETS shown in figure 6 and 7. After clicking RTP and RTSP protocols are used to get e-contents (real-time video lectures, upload, download etc).

E-Control and Management Layer

The layer comprises on several functions which are illustrated in figure 4.

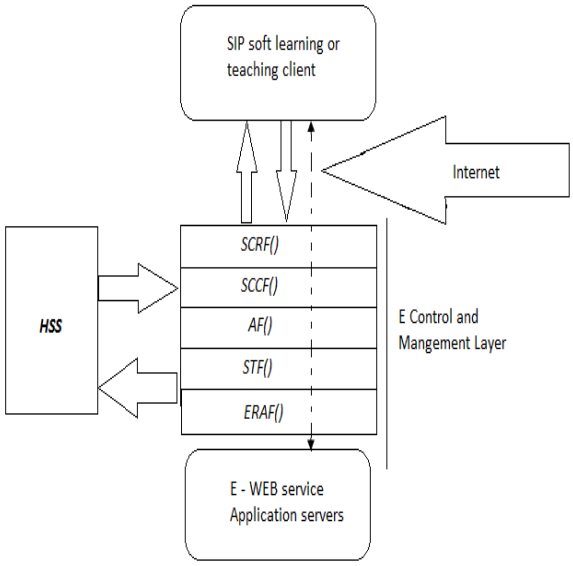

Figure-4
Functional architecture of E-control and management layer

SCCF SIP Clients control function (): Any user of E-Learning platform teacher or student are defined by system administrator on the bases of any defined condition. This definition includes SIP ID, password and other related information like designation, course list, student list for triggering desire services. The function operate on database which is HSS.

SCRF ( ) SIP Client registration function: The online sip-registration request (login, password) is received through P-CSCF. The P-CSCF is the first end point of E-Learning Core. The function extract "sipid" and passes it to HSS which then call authentication function AF().

AF ( ) Authentication Function: The AF (sql operation) matches stored user name and password in HSS with upcoming input from SCFR().

STF ( ) Service triggering Function : Trigger services like real time video lecture, white board sharing service for slow connections and so on. These services are triggered on the bases of STF () operation in which on the bases of "sipurl' the subscribed service is initiated and call ERAF().

ERAF ( ) E Resource Allocator Function: The function allocate resources such as RTP, RTSP and MRCF (multimedia resource control function). When user invoked any service like real-time video lecture, white board contents sharing, real-time questioner option etc then ERAF () is initiated at E-Core on the bases of input 'Sip request url".

E-Core Test bed and SIP Soft Learning Agent Prototype realization

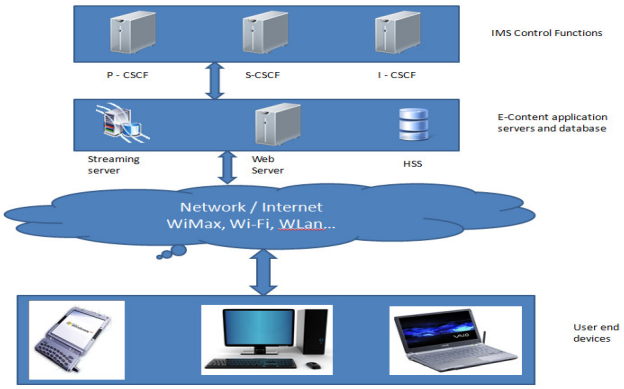

Figure-5
E- Core test bed scenario

In figure 5 the E-core test bed is implemented in a lab which is composed of IMS control functions subsystems like P-CSCF for giving entry point to subscribed users and teachers, S-CSCF for session establishment between any two entities as one is requesting to connect to other entity. I- CSCF interrogation call service control function to provide capabilities of integrating other necessary network resources for up coming SIP request. In figure 5 E-content and application servers holds learning contents for example the system is offering real-time video lecture so video acquisition system for teachers is placed in this part of the system. Also several web services like download lectures, upload lectures, whiteboard service etc are built on E-content and application servers systems.

Conclusion

In this paper an approach is realized to build personalized E-Learning service for SIP based IP network which helps as reference to mobile application developers, 3G network operators etc. In future the system performance issues, QoS and how to integrate more pedagogical aspects would be addressed.

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