Mailing-List Based Overlay Network for e-Learning Content Sharing Infrastructure among Moodle Learning Management Systems

Tohari Ahmad, Royyana M. Ijtihadie, Waskitho Wibisono, Diana Purwitasari, Ahmad Affandi [†], Herbert Innah [‡], Yoshifumi Chisaki, Tsuyoshi Usagawa [‡]

[†] Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia
[‡] Universitas Cendrawasih, Jayapura, Indonesia
[‡] Kumamoto University, Kumamoto, Japan

E-mail: tohari@if.its.ac.id

Abstract Dynamic content sharing between Learning Management Systems has been previously studied. Flexible communication model is necessary in order to spread the possibility of sharing the content among broader number of participants, as opposed to rigid configuration for each LMS-LMS connection. Publish-Subscribe interaction scheme suits well to such situation by providing interaction which primarily based on the topic they are interested in, putting behind the physical properties of connection such as IP address or host names. We present a concept of a Publish-Subscribe communication model based on mailing list system to flexibly deliver and distribute the e-Learning content activity events among participant LMSs.

Key words Publish-Subscribe, e-Learning, Learning Management Systems, Content-Sharing

1. Introduction

Higher education sector has seen e-Learning as a potential support to their academic environment. At the moment, the availability of good quality e-Learning material (content) remains a challenge due to the burden a traditional mind teachers would face when they would like to switch from conventional teaching. Sharing content among institutions can be seen to reduce burden regarding the efforts needed to develop content by themselves. Among popular e-Learning systems, Moodle [7] is the one that gains rapid popularity due to its open-source and modularity as well as its vast facilities of pedagogical support.

Content sharing among Learning Management Systems (LMS) has been studied to be implemented in which network condition is unstable and connectivity is not guaranteed [1][2][3].

The previous research implemented the rigid, point-to-point course sharing model between LMSs, which is considered inflexible and need efforts for system administrator to set-up.

In order to spread the possibility of sharing among broader number of participants as well as to support its dynamism, a more flexible way to share needs to be redefined. This paper presents the concept of employing Publish-Subscribe interaction scheme among courses within LMSs running as overlay network on top of currently popular mailing-list system.

2. Mailing-List Based Overlay Network Infrastructure for Course Sharing Activity

In the context of course sharing, a content is likely to be utilized in one-to-many fashion. That is, a particular content has a tendency to be employed for teaching at multiple LMS sites. Moreover, users may have interest not only to employ the content but also its related activities such as questions bank, forums, quizzes, lesson etc.

In some extent, the dynamism level of the content may high as a result of the interaction between the original author and the users of the course. Yet, a particular content has a potential to become popular in the future leading to increasing demand of being participants as well as a necessity to provide a more flexible sharing interaction model among multiple LMSs.

Mailing-list has been a popular tool since over decades ago employed as a discussion group infrastructure. The topic is usually specific and the mechanism of subscription is quite simple, and the interested users who joined the group member will receive e-mail messages from other subscribed users. The good thing of mailing-list mechanism is that if some problems disrupt the operation, the administrator of the mailing list could simply move the list to the other mail server flexibly. Mailing list has a potential to be employed for transporting the content updates related with content modification and another event that may occur.

Publish-Subscribe paradigm [4][5][6] provides abstraction in one-to-many interaction model. Consumers subscribe to any kind of events of interest. Producers publish events asynchronously at any time. The consumers who have matching subscription will get notifications and data associated with the events. The abstraction hides the complexity of the course structure as well as to maintain the decoupling information between course provider and the course consumer. We consider such paradigm as an overlay network on top of mailing-list infrastructure, since it requires identifier and topics organization.

3. Simple Case Study

This section provides a simple case study for the explanation in the rest of this paper as depicted in Fig. 1. This case study would assume that several Moodle LMS has installed the Publish-Subscribe plugin at each sites (A, B, C). Suppose, a teacher at A (TA1) authors a content

(CA1) with its related activities in the form of Moodle course. TA1 is willing to share his quiz (QZ) and questions bank (QB). The other modules are not shared. At the other end, teacher at B (TB1) and teacher at C (TC1) want to employ question bank and quizzes from TA1 respectively. TB1 and TC1 need to define a course (CB-1, CC-1) at their own LMS site and subscribe to the service via Publish-Subscribe module. The Publish-Subscribe module registers each site's mail address for point identifier. Therefore, any message traffic will pass through the mailing-list and reach all the sites by e-mail system. Any modifications by TA1 that may take place will pop-up a notification at respected sites regarding the topic they are interested in.
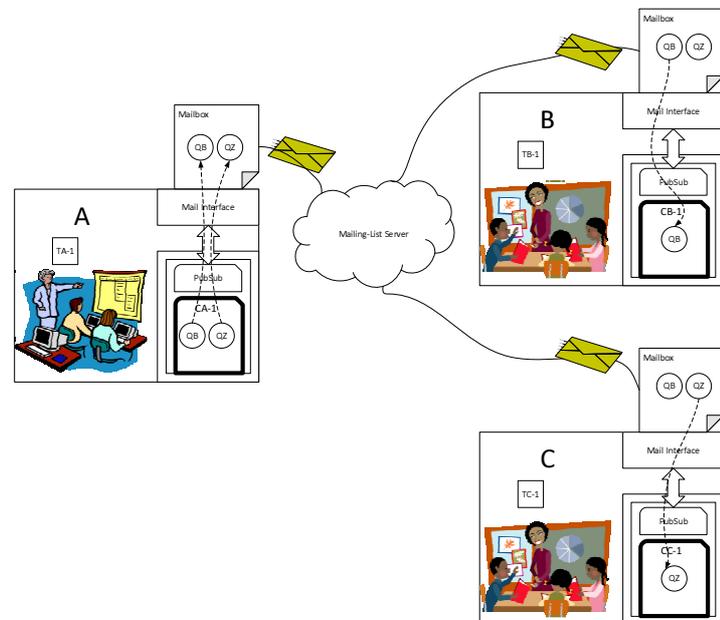

Figure 1. Simple Case Study.

3. Architecture

Moodle [7] provides several different modular extensions in order to make easy for developer to extend its existing capabilities. In this paper, the Publish-Subscribe engine module lies in top of Moodle library as a Moodle plugin. The Publish-Subscribe engine comprises of three main functions, Notification engine, publisher engine, and the subscription engine. Fig. 2

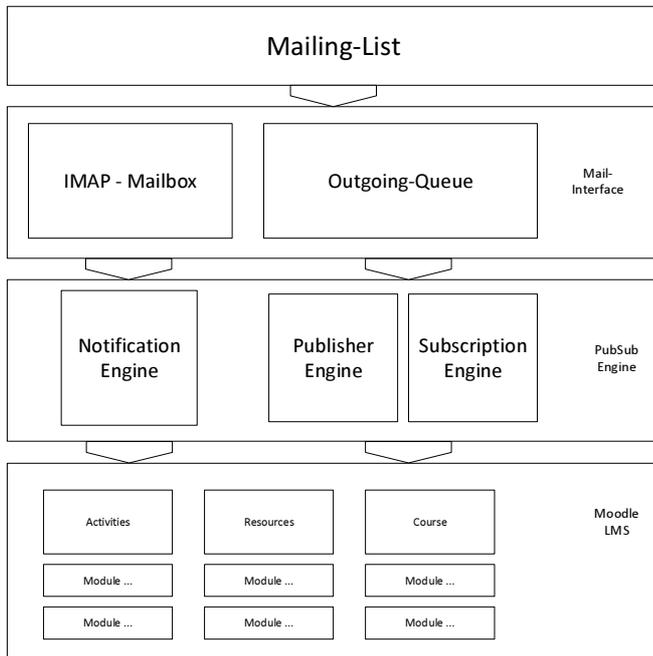depicts the general architecture of the system.

Figure 2. Software Architecture of Moodle Plugin

Notification engine's task is to access the IMAP mailbox periodically as well as filtering the incoming messages. Filtering function filters the message related with the subscription of the subscribed course. Moodle LMS library will take care of the rest by passing it to the respected module.

Publisher engine takes the information of occurring modification on any modules, forwarding those into outgoing queue and sent to mailing-list.

Subscription engine will used for storing the subscriber of particular topic.

To locate the distribution point of event, we consider a topic based Publish-Subscribe model [5] in which a hierarchy of Moodle course is employed. The top of the hierarchy will be the course's ID and course's name while the module will be placed at the rest of the hierarchy.

4. Related Works

Despite content synchronization among multiple LMSs has been studied before, it still in the form of rigid configuration for each content sharing setting. Every LMS sites which desire to share their content each-other still need to configure a point-to-point setting by their own administrator [2].

The architecture presented in this paper, is intended to be installed in Moodle as a plugin which provides a layer of abstraction that distributes the event message to the currently-popular mailing list system as well as getting notification from other sides.

5. Conclusions

In this article, we have presented the concept of Publish-Subscribe as a Moodle plugin as an overlay network infrastructure built on top of mailing-list infrastructure. The approach is still in preliminary stage at the time this paper is published.

6. Acknowledgment

7. References

[1] Ijtihadie, Royyana M., Bekti C. Hidayanto, Achmad Affandi, Yoshifumi Chisaki, and Tsuyoshi Usagawa. "Dynamic content synchronization between learning management systems over limited bandwidth network." Human-centric Computing and Information Sciences 2, no. 1 (2012): 1-16.

[2] Ijtihadie, Royyana M., Yoshifumi Chisaki, Tsuyoshi Usagawa, Bekti Cahyo Hidayanto, and Achmad Affandi. "E-mail based updates delivery in unidirectional content synchronization among learning management systems over limited bandwidth environment." In TENCON 2011-2011 IEEE Region 10 Conference, pp.

211-215. IEEE, 2011.

[3] Usagawa, Tsuyoshi, Masahiro Yamaguchi, Yoshifumi Chisaki, Royyana Muslim Ijtihadie, and Achmad Affandi. "Dynamic synchronization of learning contents of distributed learning management systems over band limited network—Contents sharing between distributed Moodle 2.0 series." In Information Technology Based Higher Education and Training (ITHET), 2013 International Conference on, pp. 1-6. IEEE, 2013.

[4] Oki, Brian, Manfred Pfluegl, Alex Siegel, and Dale Skeen. "The Information Bus: an architecture for extensible distributed systems." In ACM SIGOPS Operating Systems Review, vol. 27, no. 5, pp. 58-68. ACM, 1994.

[5] Eugster, Patrick Th, Pascal A. Felber, Rachid Guerraoui, and Anne-Marie Kermarrec. "The many faces of publish/subscribe." ACM Computing Surveys (CSUR) 35, no. 2 (2003): 114-131.

[6] Liu, Ying, and Beth Plale. "Survey of publish subscribe event systems."Computer Science Dept, Indian University 16 (2003).

[7] Moodle website, http://www.moodle.org

--