

A Development Method for Cloud-based e-Book Software-as-a-Service

Jyhjong Lin and Chaoyu Lin

Abstract—For the rapid development of internet technologies, using internet-accessed devices for on-line reading has become a must part of everyone’s day life. Among all attractive readings, e-Book is receiving more attentions in recent years for benefiting on-line readers; two typical e-Book services can be found from Amazon and Google e-Book stores. However, some desirable features for more satisfying reader needs are still not supported well in these existing services. To address this, we present in this paper a cloud-based method for the development of such desirable e-Book services (i.e., cloud-based e-Book SaaS). The method starts from the consideration of e-Book characteristics and SaaS-provision cloud features, through the recognition of the architectural components that support the employment of cloud features into e-Book, and finally ends with the deployment of these architectural components on the configuration elements in selected realistic SaaS-provision clouds for realizing the desirable e-Book SaaS.

Keywords—on-line reading, e-Book, cloud-based SaaS, development method

I. INTRODUCTION

FOR the rapid development of internet technologies, using internet-accessed devices for on-line reading has become a must part of everyone’s day life. Among all attractive readings, e-Book is receiving more attentions in recent years for benefiting on-line readers. The idea of cloud-based e-Book services is not new. Safari Books [1] was released to attempt improving the interactivity and collaboration among on-line readers under a basic concept “everything is always in sync because your library is in the cloud.” Other successful e-Book services can be found from Amazon [2] and Google [3] e-Book stores. Although e-Book has been commonly recognized as a trend for the next generation of on-line reading, many people remain reluctant to read digital documents from screens [4]. For this need, some desirable features such as recognition & comparison of desired e-Books and collaboration & communication in e-Book communities have been proposed for more satisfying reader needs to convince these book readers to accept e-Book. Nonetheless, existing e-Book services such as the two typical ones from Amazon and Google e-Book stores still do not support well these features.

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To address this issue, we present in this paper a cloud-based method for the development of such desirable e-Book services (i.e., cloud-based e-Book SaaS) that not only takes advantage of the cloud-based SaaS [5] but also possesses the desirable SaaS features under the basic concepts of social tools [6-8] and consumer support [9-11]. Therefore, the method starts from the consideration of e-Book characteristics and SaaS-provision cloud features under the concepts of social tools and consumer support, through the recognition of required architectural components that support the employment of cloud features into e-Book under the frameworks of social tools and consumer support, and finally ends with the deployment of these architectural components on the configuration elements in selected realistic SaaS-provision clouds for realizing the desirable e-Book SaaS.

This paper is organized as follows. Section 2 presents the method for the cloud-based e-Book SaaS with respective description diagrams. A prototype developed based on it is also illustrated. Some discussions about its usefulness are given in Section 3. Finally, Section 4 has the conclusions and future work.

II. THE METHOD

The method for the cloud-based e-Book SaaS has the following three steps:

1. **Requirement Identification** - clarify SaaS-provision cloud features and e-Book characteristics under the concepts of social tools and consumer support, and then identify the possible employment of cloud features into e-Book under the frameworks of social tools and consumer support (i.e., the desired requirements for e-Book SaaS).
2. **Component Identification** - determine required architectural components that support the realization of the above desired requirements.
3. **Deployment Specification** - identify the configuration elements in realistic SaaS-provision clouds where these architectural components are deployed to realize the desired requirements.

2.1 Requirement Identification

Initially, consider the characteristics of e-Book with the features of social tools and consumer support. Fig. 1 shows its possible architecture where $Reader_{1..N}$ interact with $Publisher_{1..M}$ via **Community**, **Knowledge Agent**, and **Service Agent**.

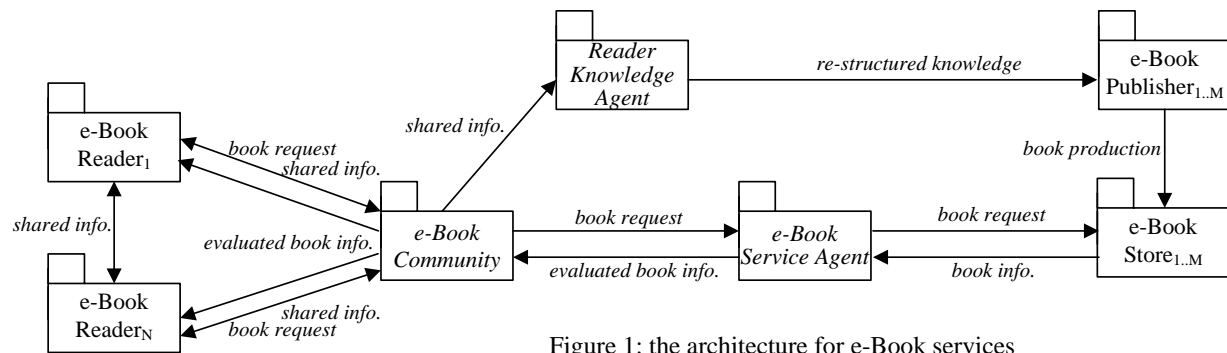


Figure 1: the architecture for e-Book services

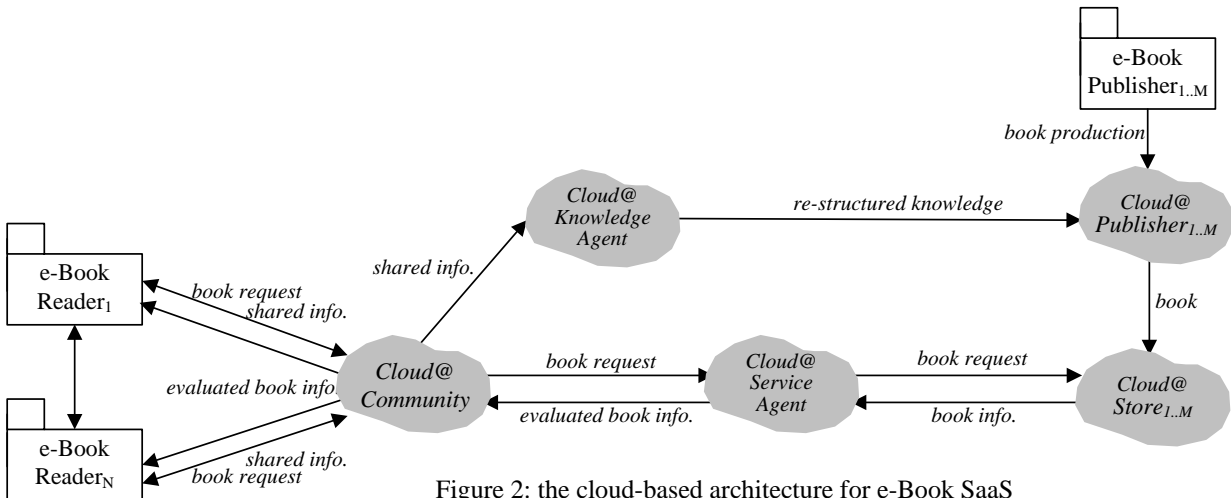


Figure 2: the cloud-based architecture for e-Book SaaS

1. It emphasizes on the community to help on-line readers share information about their desired books.
2. It emphasizes on valuable information by collecting knowledge from readers (i.e., residing in themselves).
3. It focuses on delivering evaluated book information from prospective book stores to help readers make recognition and comparisons.
4. It emphasizes on delivering the book information based on book requests from readers.

Then, based on [12], SaaS has the following features:

1. The architecture of a cloud may have a wide variety of configuration elements, including for example virtual machines, data storages, a/synchronous message queues, and user action portals/gadgets. Cloud applications may integrate the use of these elements to provide services.
2. Most of the elements in this architecture are dynamic and leverage a SOA. It is possible for clouds to interoperable among each other (i.e., interoperability among clouds).
3. Service elements such as virtual machines, data storages, and message queues may be used together to enable the customizations of services by encapsulating the desired services from prospective clouds (either local or interoperable clouds).
4. Interface elements such as user action portals and gadgets may be used to provide rich user interface controls that enable the customizations of user interfaces by

encapsulating the desired portals or gadgets in different user panels.

Finally, with SaaS features, their incorporations into e-Book as e-Book SaaS may then be identified:

1. With interoperability among clouds, respective clouds may be incorporated into the architecture of e-Book as in Fig. 2 where **Community**, **Reader_Knowledge_Agent**, **Service_Agent**, **Publisher_{1..M}**, and **Store_{1..M}** become collaborative clouds (denoted as **cloud@xxx**).
2. **Cloud@Community** enables Reader_{1..N} to share info. about their desired books where such shared info. is re-structured by **Cloud@Knowledge_Agent** into specific reader knowledge and then sent to **Cloud@Publisher_{1..M}** for Publisher_{1..M} to provide the desired books into **Cloud@Store_{1..M}** for these Reader_{1..N}.
3. **Cloud@Community** interacts with **Cloud@Service_Agent** to accomplish the book requests issued by Reader_{1..N}.
4. Based on book requests, **Cloud@Service_Agent** collects and evaluates book info. from **Cloud@Store_{1..M}** and then presents the info. to desired Reader_{1..N}.
5. **Cloud@Service_Agent** collects and evaluates the requested book information from **Cloud@Store_{1..M}** (of **Publisher_{1..M}**) and then presents the information to Reader_{1..N} for their possible recognition and comparisons.

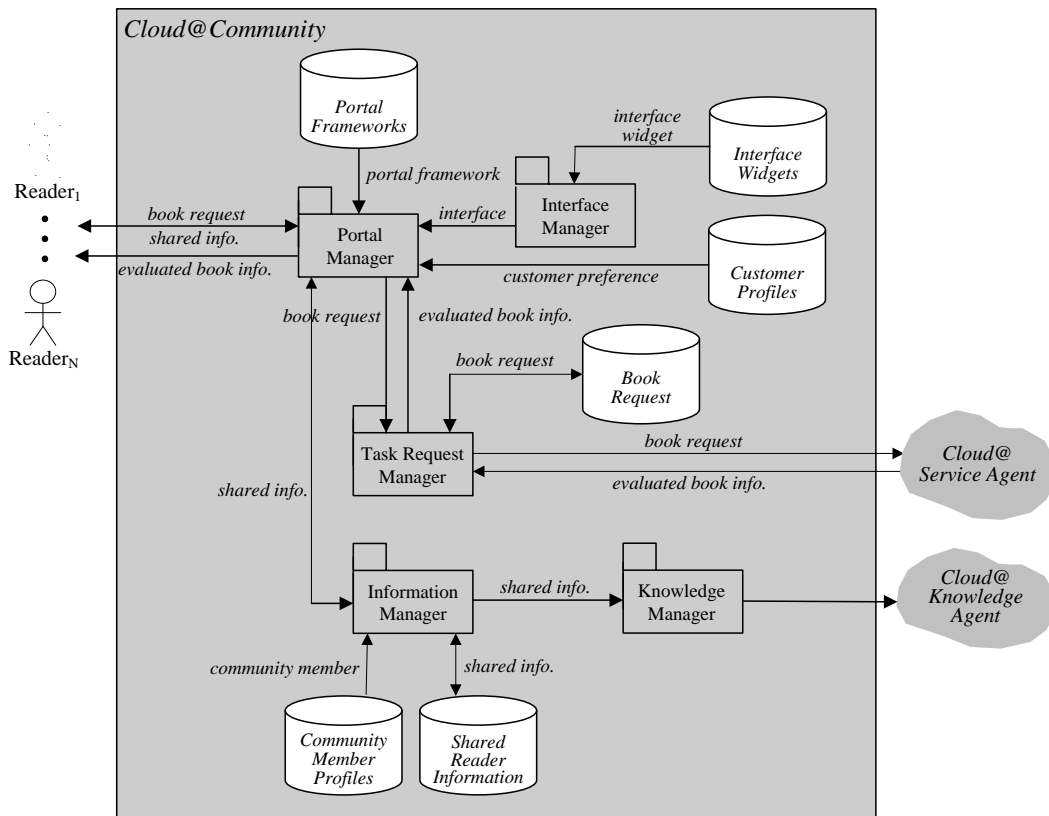


Figure 3. The *Cloud@Community* for cloud-based e-Book SaaS

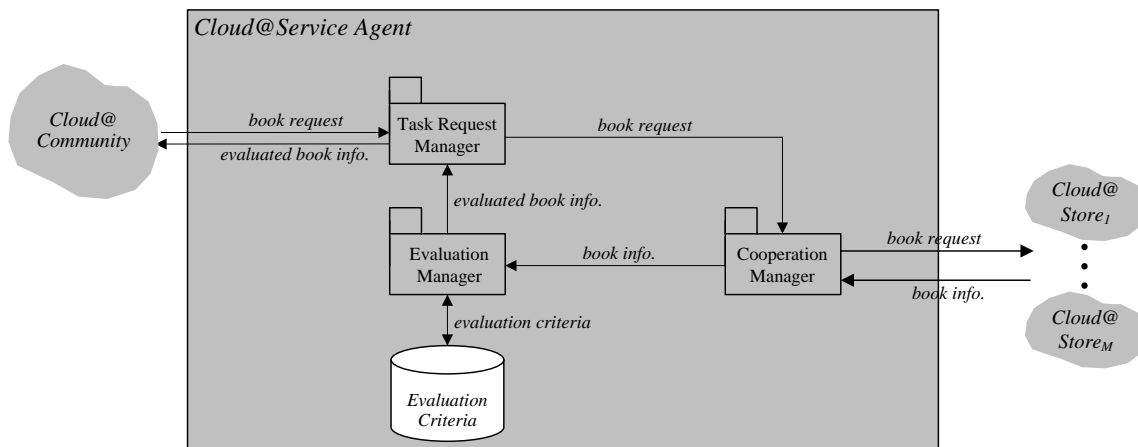


Figure 4. The *Cloud@Service Agent* for cloud-based e-Book SaaS

6. *Cloud@Community* provides Reader_{1...N} with rich user interface controls for accessing the evaluated information from *Cloud@Service Agent*.

2.2 Component Identification

With the above five requirements, e-Book SaaS should be designed to address them by the collaborative clouds between Reader_{1...N} and Publisher_{1...M}. For example, *Cloud@Community* is organized for readers to share info. about their desired books. In addition, it is responsible for forwarding such shared info. to *Cloud@Knowledge Agent* for re-structuring

into knowledge. Finally, it also cooperates with *Cloud@Service Agent* to receive the book info. relevant to those book requests from Reader_{1...N}.

In summary, these requirements for *Cloud@Community* can be described as follows: (1) helps to share info. among Reader_{1...N}; (2) forwards shared info. to *Cloud@Knowledge Agent* for re-structuring into reader knowledge; (3) cooperates with *Cloud@Service Agent* to process book requests from Reader_{1...N}; and (4) presents book info. to Reader_{1...N}. To address these requirements, it is therefore designed with six role-specific components as shown in Fig. 3.

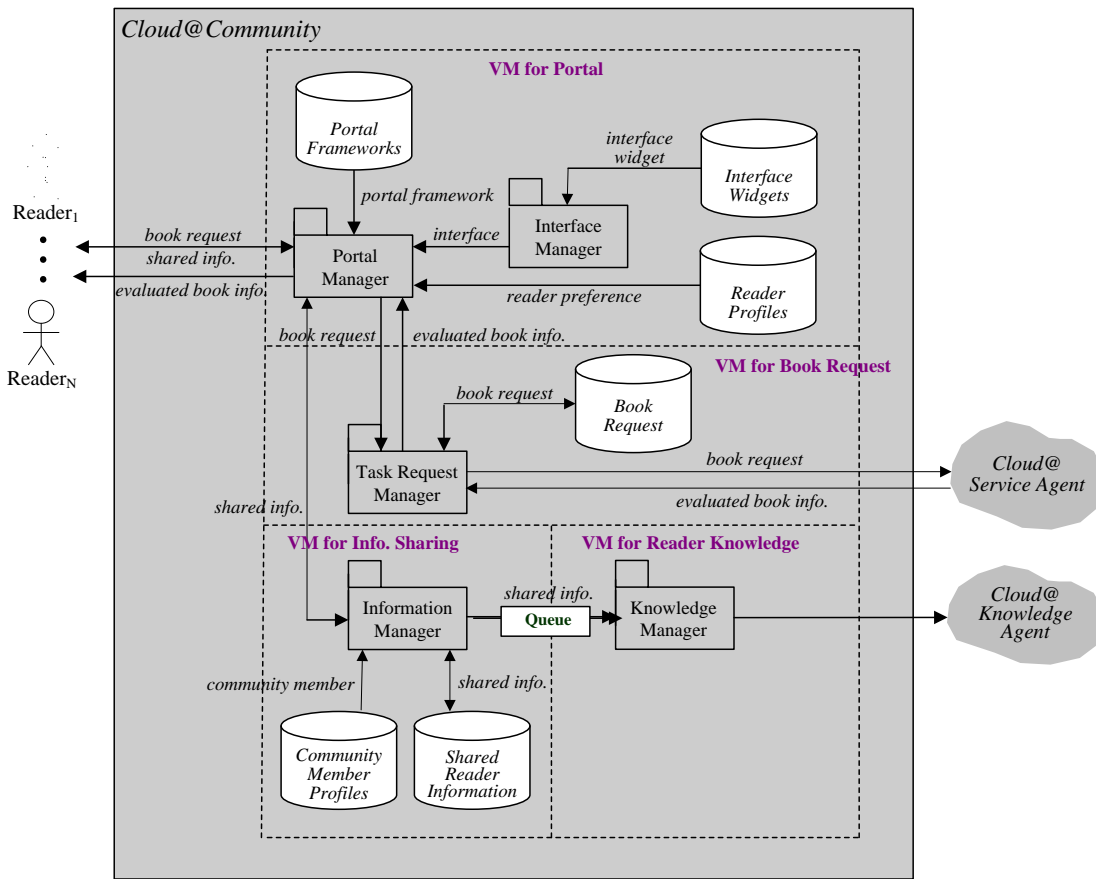


Figure 5: The Amazon EC2-based deployment of *Cloud@Community* for cloud-based e-Book SaaS

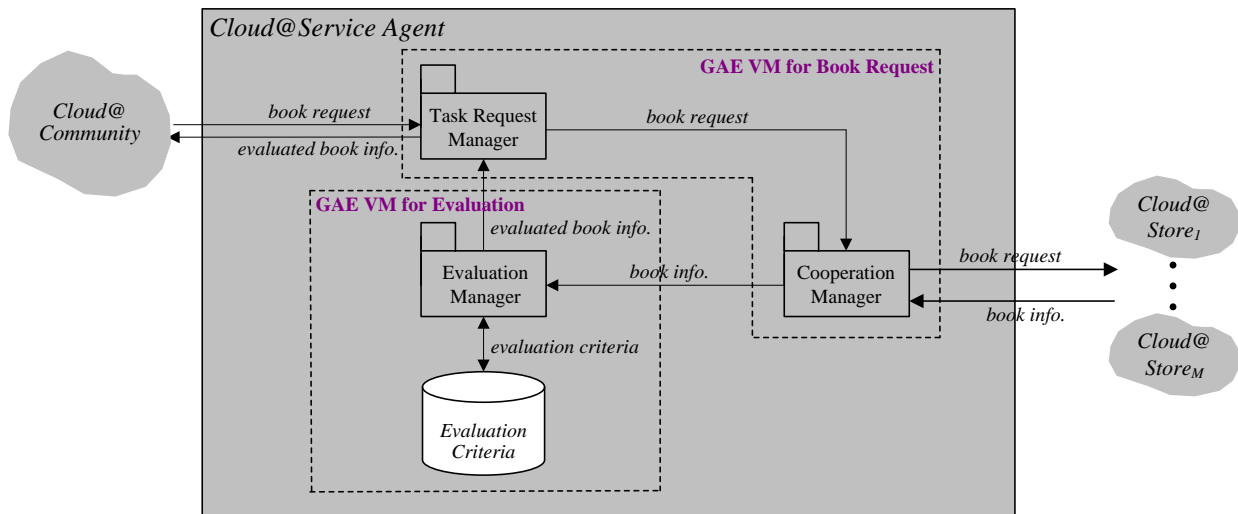


Figure 6: The Google GAE-based deployment of *Cloud@Service Agent* for cloud-based e-Book SaaS

For another example, *Cloud@Service Agent* is an intermediary between $Reader_{1..N}$ and $Publisher_{1..M}$. In general, it is responsible for forwarding the book requests from $Reader_{1..N}$ (via *Cloud@Community*) to *Cloud@Store_{1..M}* and then receiving the requested book information from *Cloud@Store_{1..M}* based on the knowledge of these $Reader_{1..N}$. Further, after receiving the requested book information, it evaluates the information and then returns it to $Reader_{1..N}$ (via *Cloud@*

Community) for their possible recognition and comparisons. To address these requirements, it is thus designed with six role-specific components as shown in Fig. 4.

2.3 Deployment Specification

With architectural components, the next is to map them into various configuration elements in realistic clouds. Such a mapping is to ensure the feasibility of further development steps

where each component follows all issues under the topologies of these clouds. Fig. 5 illustrates the mapping of *Cloud@Community* in Fig. 3 to those configuration elements in the Amazon EC2 cloud environment [13].

More specifically, respective virtual machines (VMs) are imposed for hosting its various responsible works where an asynchronous queue is particularly used for managing the two different types of works for sharing info. among $Reader_{1...N}$ in a real time work and forwarding the shared info. to *Cloud@Knowledge_Agent* in a batch work. For another illustration, Fig. 6 shows the mapping of *Cloud@Service_Agent* in Fig. 4 to those configuration elements in the Google GAE cloud environment [14].

2.4 Prototype Illustration

With the above method, a cloud-based e-Book SaaS can be constructed by developing and deploying its architectural components on the configuration elements in realistic clouds. For illustration, an e-Book SaaS prototype for e-Learning [15] in Vietnam is developed based on the above method where Java JEE is used for developing the architectural components in *Cloud@Community* and *Cloud@Store* that are then deployed on the Amazon EC2 and Google GAE respectively for providing book services to Vietnamese teachers and children.

As Fig. 7 illustrates, *Cloud@Community* provides the service for enabling $Reader_{1...N}$ (i.e., teachers) to share information about their desired books (i.e., Hide and Seek Harry at the Beach). After then, for their teaching purposes, teachers may issue book requests to *Cloud@Store*. As shown in Fig. 8, some information about those requested books is returned from *Cloud@Store* and then presented to these teachers for their selection as teaching materials. Finally, as in Fig. 9, once selected by these teachers, the selected books are provided by *Cloud@Store* and then accessible via the customized user interfaces in *Cloud@Community*.

III. DISCUSSIONS ABOUT THE METHOD

In this section, the usefulness of applying the e-Book SaaS on more satisfying reader needs to convince book readers to accept e-Book is discussed as below.

1. As shown in Figure 2, e-Book SaaS supports effective interactions between readers and publishers where reader information is collected as knowledge for benefiting publishers and book information is provided by publishers for satisfying reader needs. In general, e-Book SaaS alleviates the shortcomings in existing e-Book services such as Amazon and Google e-Book stores where the desirable features for recognition & comparison of desired e-Books and collaboration & communication in e-Book communities are specifically addressed for more satisfying reader needs to convince book readers to accept e-Book.
2. Also, as shown in Figure 2, SaaS-provision clouds are imposed on its architectural constituents that each plays a specific role and their realization may be achieved by selecting suitable ones from those existing realistic clouds that satisfy their role requirements. As one may conceive,

such cloud selections raise some specific issues, e.g., existing realistic SaaS-provision clouds need to be specified in formal ways from which suitable ones can be selected by automatic means. In general, many discussions about these issues have been presented where semantic ontologies [16-19] are most commonly used in that they support well (1) the ontological specification of existing realistic clouds; (2) the ontological representation of the role requirements for each architectural constituent; and (3) the selection of suitable ones from these existing realistic clouds by an ontological matching of the role requirements with these existing realistic clouds. Since the e-Book SaaS is constructed from the identification of the role-specific components in each architectural constituent to the deployment of these components on a suitable cloud, it therefore supports well the aforementioned cloud selection issues.

3. The e-Book SaaS is constructed by a thorough work for describing e-Book SaaS with considerable issues specifically concerned. It follows a step-by-step manner to specify the architectural requirements, the architectural constituents, the components in these components, and how these constituents/components are deployed to suitable clouds. We believe these steps are quite helpful for understanding and describing the requirements for e-Book SaaS and how to achieve them by the collaboration among deployed cloud components. Generally speaking, the method supports well the architectural specification and component design for the development of e-Book SaaS.

IV. CONCLUSION

In this paper, we present a method for the development of the e-Book SaaS. The method starts from the identification of e-Book characteristics and SaaS features. After then, the cloud-based architecture and deployment of system components are specified to support and realize the incorporation of SaaS features into e-Book. For e-Book SaaS, these cloud-based components focus on supporting both of the knowledge from on-line readers to book publishers and the reverse delivery of book information from book publishers to on-line readers. In particular, within the context of realistic clouds, prospective configuration elements are specifically identified where architectural components are deployed to realize the e-Book SaaS.

In general, for the advances of internet technologies in recent years, on-line reading has become a must part of everyone's day life. It is therefore for e-Book to receive more attentions for benefiting on-line readers. Many successful e-Book services can be found from the market such as those by Amazon and Google e-Book stores. However, some issues can still be found in the context of on-line reading where the most critical one seems as that many people remain reluctant to read digital documents from screens. To address this issue, some desirable features such as recognition & comparison of desired e-Books

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Figure 7: The teachers share information about the book “Hide and Seek Harry at the Beach” in *Cloud@Community*

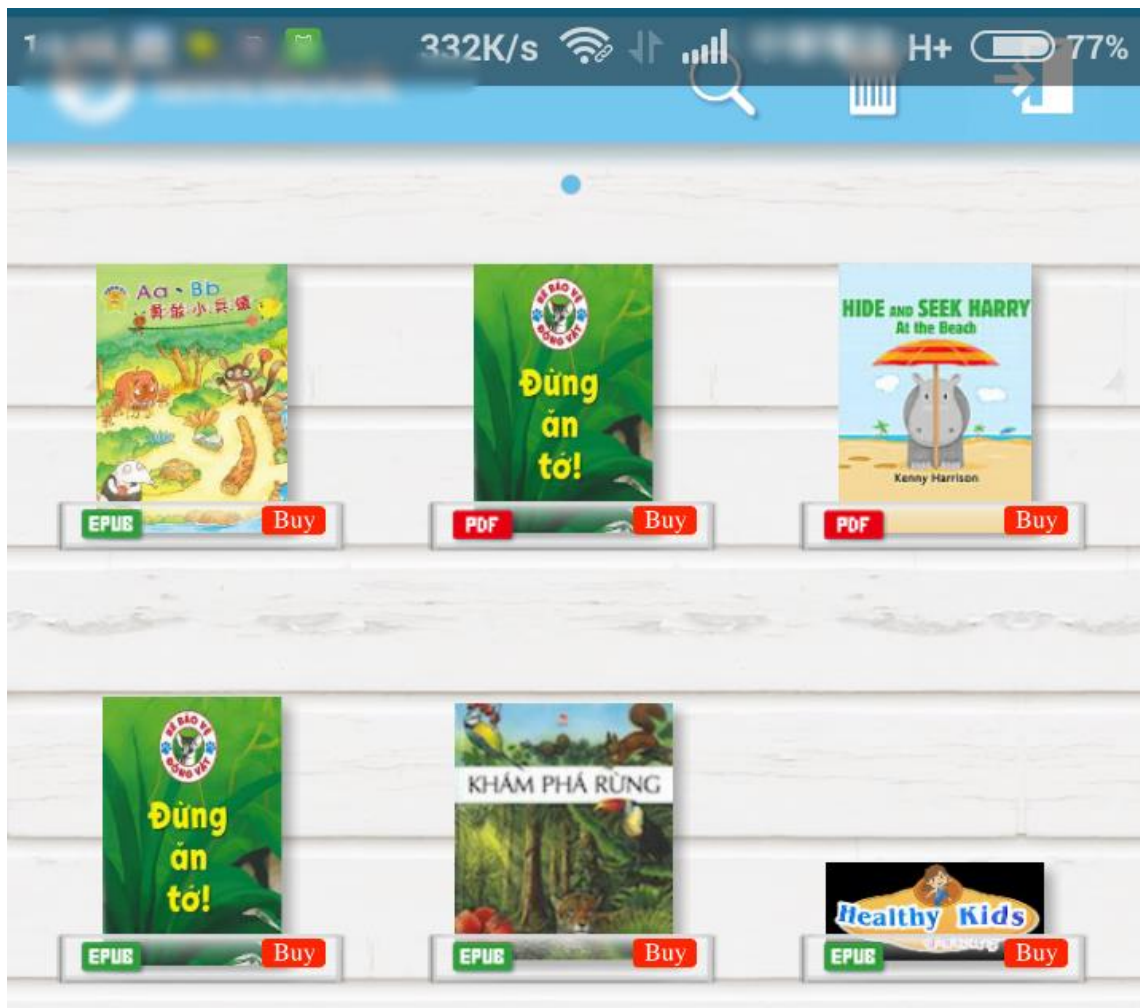


Figure 8: The information about requested books from *Cloud@Store* for teachers to make selections

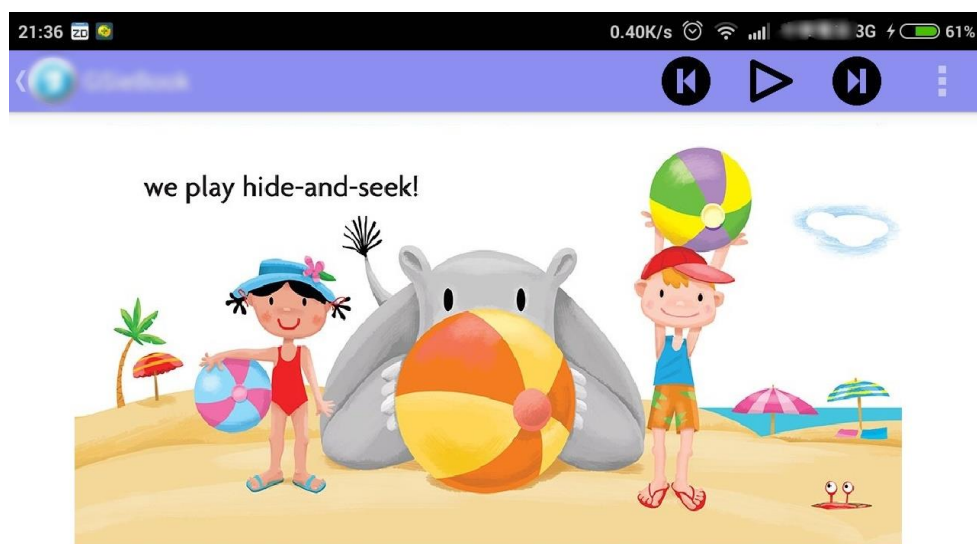


Figure 9: The selected books from *Cloud@Store* for teachers to access as teaching materials

and collaboration & communication in e-Book communities have been proposed for more satisfying reader needs to convince these book readers to accept e-Book. As such, the method herein is presented not only taking advantage of the

cloud-based SaaS but also possessing these desirable features by employing the frameworks of social tools and consumer support in its components.

As our future work, we will continue to explore the

construction of the e-Book SaaS by applying well-known cloud computing techniques like Amazon EC2 [13] and Google GCE/GAE [14,20] cloud environments. Thereafter, we will look forward to the practical use of our work in various domains like e-Learning systems; its usability on such cloud-based customer support systems will also be carefully experienced.

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