A Proposed Model of Cloud based e-Learning for Najran University

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***Abstract*—For the time being, the educational institutions are keen to use e-learning in their educational environment. This, in turn, will support their learning process and allow the learners to access any service or learning material or information at any time they need it. With all the pros by the e-learning, it still suffers from many problems that are explained clearly in this paper. In contrast, along with the innovation of cloud computing technology as a new paradigm in the IT world. With the establishment of cloud computing, numerous services for numerous fields (e.g., education, business, and government) have been introduced that have greatly facilitated the e-learning. In this paper, it demonstrates how the inclusion of the cloud computing paradigm in the e-learning environment assist positively. A lot of obstacles that are introduced by e-learning have been remedied. It combines the cloud computing in the e-learning system, thus, the proposed E-learning Embracing Cloud Computing Model (ELECCM) has completely developed and performed with all the essential components that are needed for their architecture. The study presents all the procedures that are run in order by the proposed system. Then, a fully functional e-learning system based on cloud computing; with low cost and low technical barriers, is demonstrated and explained clearly.**

***Keywords*—E-learning; cloud computing; E-learning Embracing Cloud Computing Model (ELECCM); SaaS; PaaS; IaaS**

I. Introduction

In the digital world, in which the new technologies are emerging rapidly and radically, the innovative e-learning methods must be facilitated to allow to transfer the more effective knowledge and to enable to participate for lifelong. The fact that traditional e-learning methods are inadequate to meet the needs of advanced e-learning processes, especially in higher education. Higher education highlights the experiences and outcomes of higher learning that require a major transformation in the knowledge and communication community [1]. E-learning is the way to deliver an instruction electronically partially or solely through a web browser, such as Netscape Navigator, via the Internet or multimedia platforms (CD-ROM or DVD) [2]. Due to the high accessibility of network bandwidth, the World Wide Web has been extensively used as a medium for displaying and delivering teaching material, etc. Currently, the events and activities of e-learning are conducted via various electronic media. Educational and technological aspects have become progressively important facets in e-learning content development [3]. The e-module interface design and the usage of interactive multimedia elements are frequently being focused on designing e-learning content [1].

E-learning offers many benefits such as flexibility, diversity, and measurement, although it still faces many difficulties in its implementation [2], [3]. With the experienced, the high initial cost; namely the economic factor, was the main problem they are facing when they are starting e-learning. It is the main concern by the institutions whose interest to implement e-learning; for example, the students in a university with different departments may need to access to a lot of computing resources (hardware and software) [4], [5], [6]. Infrastructure, Maintenance and Human Resources are the main issues that are considered by the initial cost. The access to the learning material is another problem that might occur when implementing e-learning [4]. Any university can develop its own e-learning system. Any conventional e-learning system; Figure 1, may cause a lot of problems. They are such as the time consumed to design the system, the costs needed for infrastructure or for the appointment of professional staff to maintain e-learning and promotion system [6].

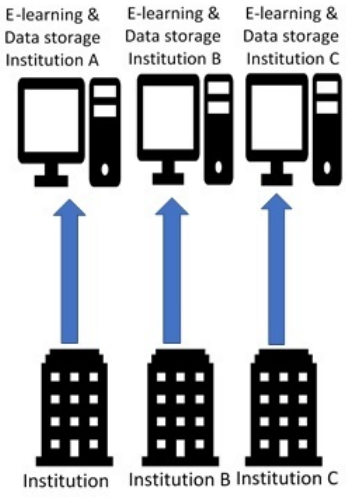

Fig. 1. Conventional E-Learning

In this paper, a proposed e-learning model based on cloud computing services introduced, namely E-learning Embracing Cloud Computing Model (ELECCM). The proposed ELECCM has completely developed and performed with all the essential components that are needed for their architecture. The study presents all the procedures that are run in order by the proposed system.

The rest of the paper is organized as follows. Section II explores an introduction cloud computing. In Section III, the proposed architecture is explained in detail starting by the

important procedures, the layers details, and ending by the details of the proposed model of the cloud-based e-Learning. Finally, the paper concludes in Section IV.

II. The Cloud Computing

Cloud computing has been one of the most important advances in information technology in the last decade since then it has become mainstream [7], [8]. Numerous layers of services have been introduced with establishing grid computing, all people from academic fields, business, consumers to governmental officials were enjoying the revolutionary experience of cloud computing. The benefits of cloud computing in which e-learning became easily apparent. First of them, no worries by the developers of e-learning about the balance between hardware and resources, thus reducing their reliance on professional knowledge [9]. Secondly, it is sufficient for the users of e-learning systems to have some lightweight, low-cost devices (e.g., smartphone, and tablet) to access and contact with the e-learning systems via the internet. Finally, all the data used in the e-learning systems (e.g., reports or personal notes) would be easily stored and backup automatically. Thus, the time needed to manage data is reduced and the storage spaces, with improved security [7], [9], [10]. Usually, applying the e-learning on cloud environment will strongly help the educational institutions to utilize the e-learning services which run in the cloud environment; Figure 2. It would be enough for the institution to only rent the cloud computing provider's infrastructure. Similarly, with the maintenance and the human resources for the development stages in which the e-learning environment has been established by the provider of the cloud service. Accordingly, it reduces the costs required by the institutions to implement the e-learning based on cloud computing because it will not be needed by the institutions to pay to buy [4].

Figure 1 and Figure 2 explain the big change in the e-learning era and how to shift from the conventional e-learning to the cloud-based e-learning. The cloud-based approach helps to reduce the cost of implementing e-learning in the educational institution. As shown in Figure 1, the basic elements in the implementation of conventional e-learning are system upgrade, system maintenance and e-learning system development [11]. However, the conventional e-learning is suffering from several problems in terms of scalability flexibility, and accessibility that may affect its performance [12]. The scalability is considered as one of the important features of the cloud e-learning. This feature helps virtualization infrastructure layer provided by the cloud service provider. Virtualization helps solve the problem of the physical barriers that are generally inherent in the lack of resources and infrastructure to automate the management of these resources as if they were a single entity through hypervisor technologies such as virtual machine (VM) [4], [11]. As a result, we believe that the cloud-based e-learning system is considered the best way that combined the education with the information technology fields. Hence, this study report and display the proposed model that emerged by employing the cloud computing technology into e-learning along with the setup procedures [6].

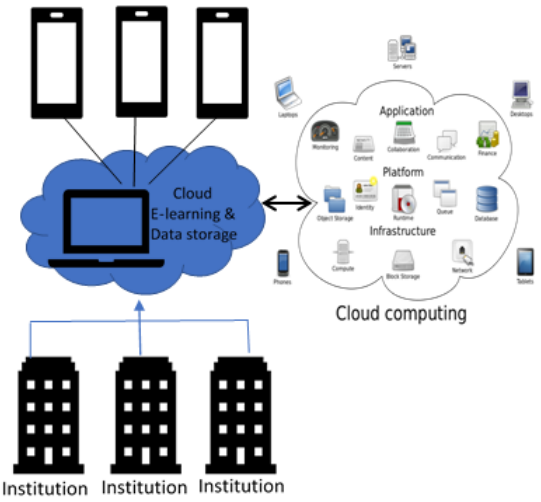

Fig. 2. Cloud-Based E-Learning

III. The Proposed Architecture

A. An Overview

Figure 3 shows the general architecture of the proposed cloud e-learning [3], [13]. The proposed (ELECCM) system components are the cloud partners which connect with a cloud central system through several local servers. In the figure, each PC user has the property of any specific educational institute/university and it works as a cloud partner that provides the needed resources for the cloud system from its available resources. Each local server is also connected with each institute/university. Each local server will monitor the PC user status up to each request from the associated institute/university [13], [14], [15]. In general, the procedure is when requests from the users whom associated with a specific local server are submitted to the cloud through it. Then, the local server collects these requests from the clients in its domain during a certain time period. It verifies as well as forwards the requests. On the other side, different providers with different services for the users are available. These providers should have the agreement with the cloud system [13]. The following will explain each procedure in the proposed system exhaustively.

1) Request Configuration Procedure: As shown in Figure 3 that each user (cloud partner) receives their requests from the cloud sides via the local servers that communicate with. This procedure can be depicted in Figure 4 and the steps are as follows:

1) First, the user does a request. Then, the local server will receive the request that associated with required identification information of the user (e.g. password/ User ID).
2) Each local server does the authentication and verification process for each user. Then, it sends a form with a suitable graphical user interface (GUI). This GUI differs according to the type of the user (e.g. student, lecturer, etc.).
3) The user determines the needed services via the user interfaces. After getting the user requests, the

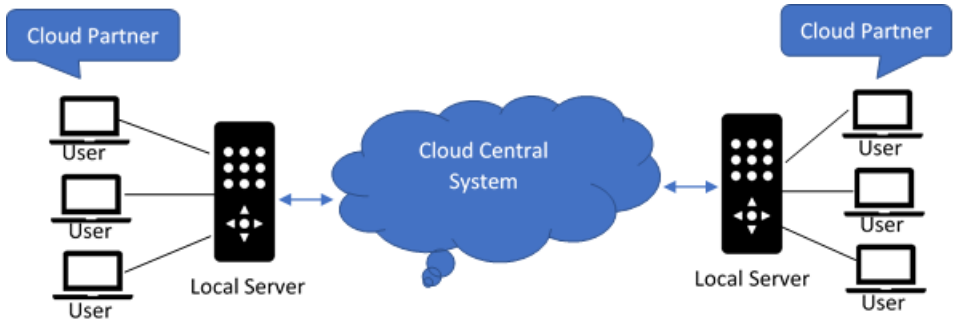

Fig. 3. The General Architecture of the Proposed ELECCM

verification should be done by the local server. This verification includes the instantly available resources, policy to the cloud like pricing policy, encryption system and other data security.

4) If the user has no agreement to receive the requested services or if the pricing policy is mismatched, then the local server directly informs the user for alternatives such as payment through credit card.
5) Otherwise, if the user agrees with the current policy, a reply; an acknowledgement message, will be sent to the local server.
6) Finally, the local server sends the requested resource to users when it receives the cloud system resources.

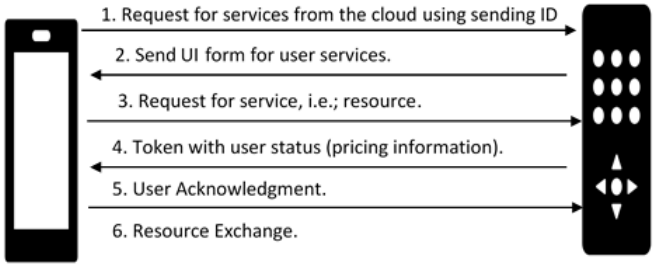

Fig. 4. The Communication steps between the User and Server

2) Resource Monitoring Procedure: Some resources which are unused, the cloud system sends a periodic message; salutation message, to each institute/ university associated server. This message is sent to search for the status of the respective clients. Each server reproduces various copies of that salutation message and then forwards each message copy to the respective client under its domain. The Resource Information Message from all clients of the server will be received by the server, and then the server will generate a summarized message based on the information that it collects. From the client and send back the message to the cloud system. The resource identification procedure is shown in the figure 5.

Fig. 5. The Flow Diagram of sharing the Resource Information

3) Resource Allocation Procedure: At a particular time, the server collects the client's requests under its domain. Moreover, summarizes and combines the overall requests based on the individual group of services. Assume, the university server accepts two distinct clients' requests. The first client request with 10GB storage size and a Microsoft office. While the second request for 15 GB storage with two different software such as Antivirus and visual C++. The university server will summarize both requests as 25 GB storage with all software's, i.e., visual C++, Antivirus and Microsoft office. As soon as both requests are received by the cloud system from the server, all the requests (25 GB of storage, Microsoft Office software, one Antivirus software and visual C++ software) are sent to the clients. Generally, the structure of the Cloud Central System consists of two sub-layers; upper and low-sub-layers. The upper sub-layer carries out several processes such as authentication and credit verification before offering any service. Moreover, the upper sub-layer is associated with government central system to control and monitor the cloud system processes. Furthermore, the cloud lower sub-layer can provide more four types of services based on the user requests. These are Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS) or e-Learning tools. IaaS, PaaS and SaaS represent the layers of any cloud computing. Figure 6 illustrates the architecture of the cloud system.

The Upper Sub-Layer: The security is an important issue in the cloud system. This is because the services in the cloud system are accessed over the internet. Each client can select its own security methods such as the needed encryption process. Furthermore, the cloud system has to agree the all methods with the local server to interpret them. As well as, the users in our educational system are at several levels so the request for services is diverse. The access method will be maintained by identifying the services and user types. The policy among the user and provider will be defined by the sub-layer and will be depended on multiple factors. Examples of these factors are the user level, the latency and the throughput. Based on the policy, different priorities are set by the government for the users. For example, the higher priority users can access the resources with lower latency. The policy also guarantees the provider to run the software smoothly with maximum throughput and highest load balance. Moreover, an authentication and credit verification sub-layer are required in this layer to verify the local server as soon as a request for resources is coming from the server end. It also authenticates and verifies the

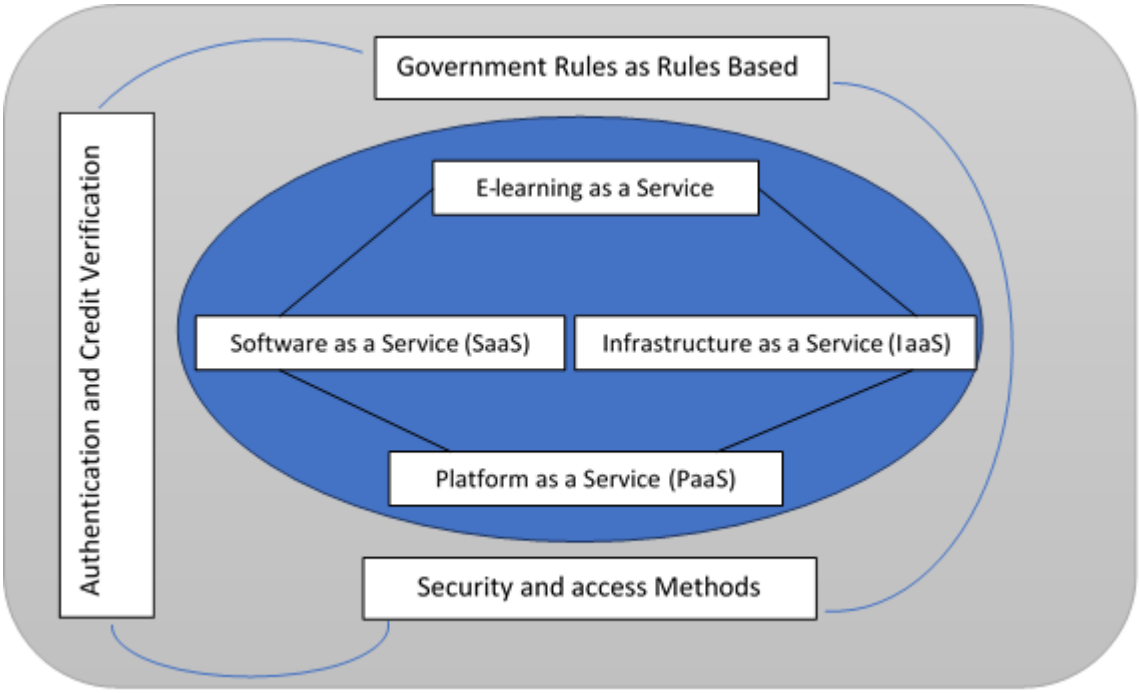

Fig. 6. The internal architecture of ELECCM system

user credit information for the requested service; if he has sufficient balances for the requested services it accepts and transform the requests to the lower sub-layer. As soon as the lower sub-layer confirms the request it adjusts the user account after deducting the amount for the requested service. Rules by the Government are set; they named the planning and monitoring committee. For example, the planning committee decides the prices for different types of services based on analysis and agreement with the cloud partners. It also decides the number of funds needed to be allocated to an individual organization. The corruption monitoring committee monitors the daily proceedings of every institute and all objections come from the users' end (e.g. unmatched software).

The Lower Sub-Layer: The lower layer of the cloud architecture allows accessing the private resources that are user request. The lower layer is waiting for the positive acknowledgement that will be sent from the upper layer. Once the lower layer receives the positive acknowledgement, it provides the user requested services. The interaction will be established between the vendors and clients under the responsibility of an instrumental panel in the layer [16]. The layer has an operational panel in which it performs different tasks such as monitors the circumstances, handling the PCs and managing the images. This panel will include a script tool for controlling, monitoring, configuring, and maintaining the clusters. This tool is named as Extreme Administrator Toolkit (xCAT). Each request arrives from the server ends in the form of bare-metal image format is first loaded on xCAT and then process by the virtual cloud system.

B. The Proposed Model of Cloud-Based E-Learning

Actually, the e-learning is just updating the tools, concepts and techniques. The e-learning can't replace the teachers completely. The e-learning will not replace the functions and roles of the teachers. It only provides new content, methods, and concepts for education. Moreover, the teachers will still the backbone of the learning as well as developing and making use of the e-learning based cloud. Recently, many e-learning cloud computing models have been proposed by researchers [17], [18]. According to USA NIST's definition, cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction [18]. In this section, the architecture of our proposed ELECCM is presented; in details. The model is consisting of five essential layers, namely as (1) infrastructure layer, (2) platform layer, (3) services layer (4) clients-access layer and (5) user layer. They are depicted in Figure 7. The first layer is the hardware layer. It includes all the hardware, computing and storage capacity for the high-level layer.

The infrastructure layer contains resources and architecture that supporting infrastructure, such as virtual machine, cloud platform. It shares the IT infrastructure resources and connects the system huge system pool together to provide services. The cloud computing enables the hardware and infrastructure layers to work like internet/intranet. Then, the data resources can be accessed in secure as well as scalable way. The third layer is the platform layer; the software resource layer consists of middleware and operating system. Different software resources are integrated by the technology of middleware to develop a unified interface for software developers to develop applications and embed them in the cloud. The operating system in which the e-learning application will be running in this layer. The fourth layer is the service layer; namely SaaS. In SaaS,

the cloud computing service is provided to customers. Web Services, Multimedia Applications, Business Applications are examples of the provided services. The client-access layer is the fifth layer of our proposed architecture. The access layer which consists of multi-channel access from multi devices for addressing the access issue to cloud e-learning services which is available on the architecture such as types of access devices and presentation models. The concept of multi-channel access that allows a variety of available services which can be accessed through a variety of devices (e.g., computer, mobile phones, smartphones) and a variety of presentation models (e.g., desktop, mobile applications). The final layer in our proposed ELECCM system is the user layer which consists of the provider, administrator, teacher and student.

IV. Conclusion

In this paper, a complete E-learning Embracing Cloud Computing Model (ELECCM) had been developed with all essential components that are needed. The proposed model considered a lot of the obstacles that may be the e-learning suffered. The study also demonstrated how the including of the cloud computing paradigm in the e-learning environment can be assisted positively. Furthermore, presented all the procedures that are run in order by the proposed system. As a conclusion, a fully functional e-learning system based on cloud computing; with low cost and low technical barriers, is demonstrated and explained clearly.

Acknowledgment

This paper was funded from Scientific Research Deanship at Najran University under No NU/ESCI/15/035.

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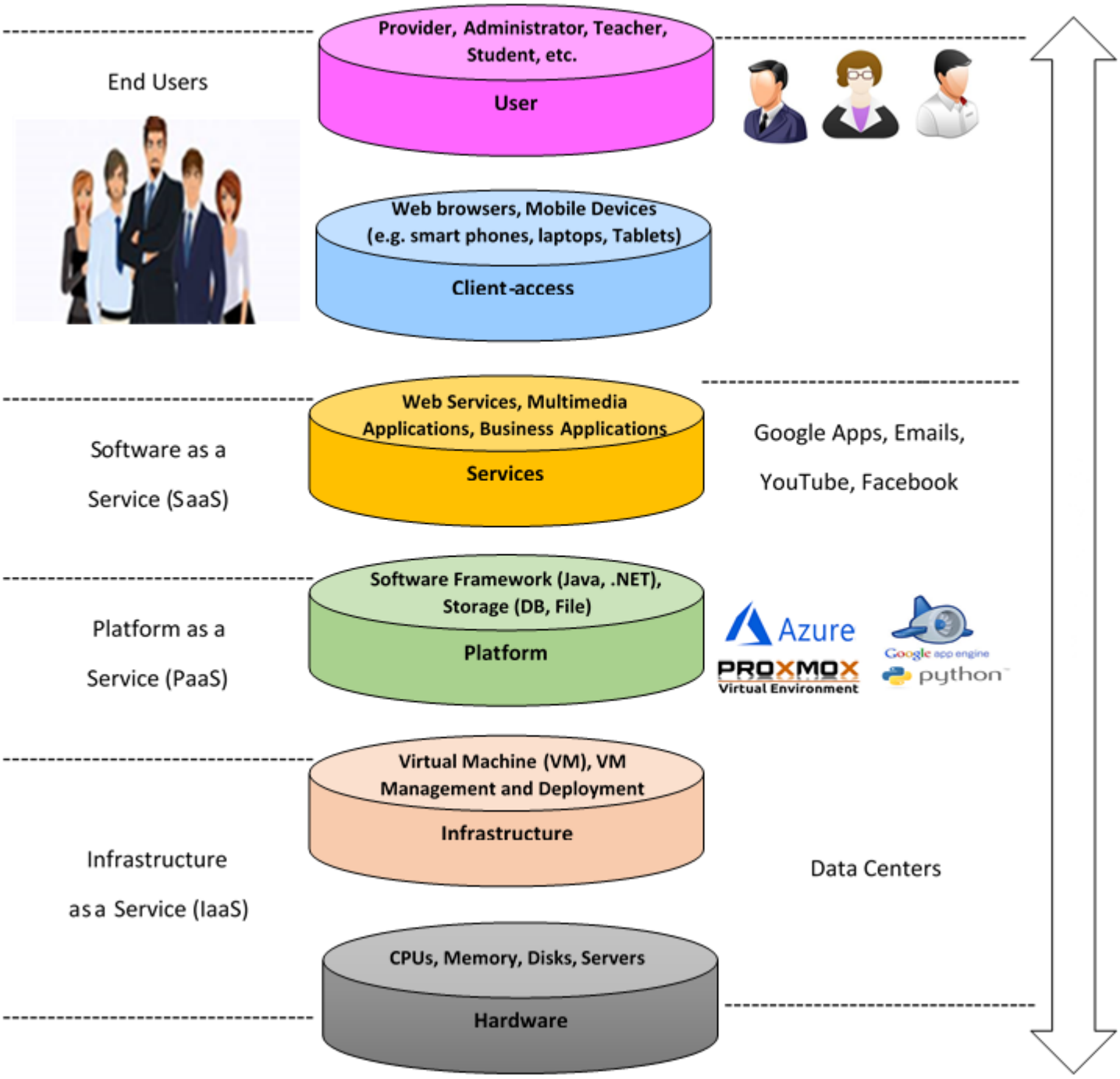

Fig. 7. The architecture of the proposed ELECCM system