A Proposed Architecture of Cloud Computing for Education System in Bangladesh and the Impact on Current Education System

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Abstract
In this modern era the developing countries will be remain mired in poverty unless they preoccupy more on widening the technology and innovation to everywhere throughout the country including urban to small rural areas. The essence of Computer is now swelling in such an extent that we can not think a single moment without Computer; everyone residing in a country now needs to be proficient in different aspects of Computer system and enlightens themselves with the innovative research works that will thrive their daily life style. However although the Computer Education is now indispensable for people of every stratification but due to the poor economic condition many countries are unable to introduce their inhabitants with rich technologies and innovation developed by computer system. Consequently a shared based system evokes for uniform distribution of resources between people of every stratum. In this research work we are introducing an architecture of Cloud Computing for education sector and discuss the impact of our propose architecture on the availability of widespread resources to all around the country. We are presenting here a comparative analysis of our proposed architecture with the existing one to demonstrate the advantages of the proffered architecture over the current one.

Index Terms
Cloud Computing, Cloud Architecture for Education, Benefits of Cloud Computing, Impact of Cloud on Education.

I. INTRODUCTION

Cloud Computing [1-3] is considered as a paragon that render apropos, expeditious network admittance to an earmarked pool of constructible computing resources which can be outfitted and exempted with just nominal diligence and service providers reciprocation [4],[5]. The resources can be network servers, applications or services. Cloud computing delivers services autonomously based on demand, provide ample network access, resource reservoir and effectual flexibility.

In the recent years cloud computing is considered as the most ubiquitous technology for its litheness in deploying and scaling applications which is derived gradually from the perception of virtualization, distributed composition, grid and enterprise IT administration [1]. However cloud computing can propound different services for diverse users if we can facilitate virtualization technology and provide powerful storage and computing capacity of PC's and servers. Cloud computing features can be fragmented into three distinct segments; software as a service (SAAS), platform as a service (PAAS) and infrastructure as a service (IAAS) each of which accomplishes a specific purpose and supports different products for organization and individuals throughout the world [6]. In addition we can also provide e-Learning service to the students which include management utilities and interfaces to support the part of learning process [7]. The different segments of cloud computing features are offered to the user through a variety of ways such as pay per use, fee-based infrastructure with value-added application services, or free services for vendors but sharing of revenues generated from consumer. In Section II we provide a brief overview of the structure of our education system, in Section III we are introducing our proposed architecture. Section IV describes the benefits of our proposed architecture by a comparative analysis with the structure of current education system. Finally the paper is concluded in Section V.

II. BACKGROUND

The education sector in Bangladesh is divided into four different segments namely Primary Level (years 1 to 5), Secondary Level (years 6 to 10), Higher Secondary Level, (years 11 and 12), Tertiary Level. There are a total of 80397 numbers of primary school, 13224 numbers of Secondary school and 125 institutes at tertiary level [8]. This necessitates different requirements of educational resources (hardware, software, study materials etc) for each of these levels of users. Recently the government is giving maximum priority to human resource development through education and tries to percolate education for all people over the country. Although the government of Bangladesh allocates maximum budget for the development of its educational arena in the recent decades but still the literacy rate is not increasing commensurately. The main reason is the improper distribution of educational resources such as teaching tools, teaching stuffs and lack of monitoring as well as inefficient

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administrative procedure. In addition this is not an easy way to implement the governmental policy in regard of educational course curriculum due to lack of communication. As cloud computing technology binds the resources into a single domain, we believe this technology can be a prominent solution for solving the educational problems in Bangladesh.

III. PROPOSED ARCHITECTURE

Our proposed system primarily is composed of cloud partners, local servers and cloud central system.

The architecture is depicted in figure 1.

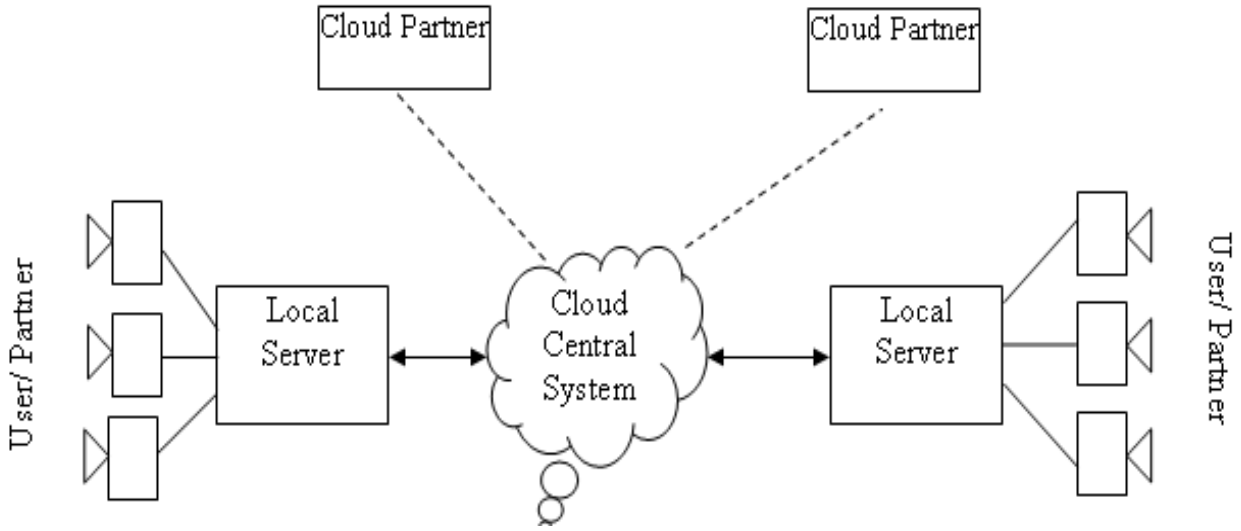

Figure-1: Cloud Computing Architecture

According to our proposed architecture each individual PC act as a cloud partner which offers the necessary resources to the cloud system from its available resources. However each of these individual PC is the property of a particular educational institute whereas the institute owned those PCs from the budget sanctioned by the government for that particular institute. There is a local server associated with individual institute who monitors everything ranging from PC status to individual requests for that institute. The users associated with a particular local server submit their request to the cloud via the local server. The local server collects the entire request from the clients in its domain within a specific time period and forward those request after verification. In addition there are some providers who have the agreement with the cloud system and offers different services to the user.

A. Request Initialization Procedure

According to our propose architecture each user terminal communicates the local server for receiving services from cloud sides. The procedure is depicted in figure 2.

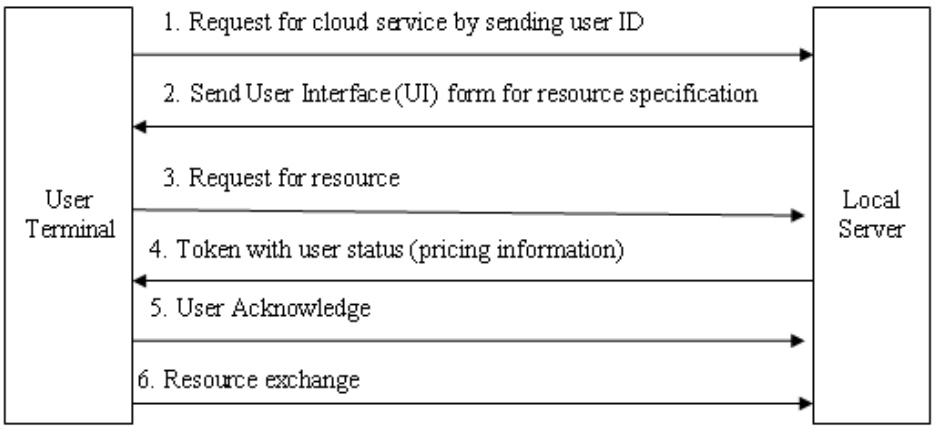

Figure-2: Steps of Communication between End User and Server

The steps of the procedure are summarized bellow:

1. First of all user request is sent to local server with necessary user identification information like user id and password.
2. The authentication module of local server verifies the user. It then sends a form with appropriate graphical user interface (GUI) according to the label of user.
3. User provides exact service specifications through the user interfaces. After receiving the exact specification from user the local server verifies the current available resources, policy to the cloud like pricing policy, encryption system and other data security etc.
4. If the user does not have an agreement to receive the requested services or if the pricing policy mismatches, the local server immediately informs the user for alternatives like immediate payment or payment through credit card etc.
5. If the user agrees with the current policy it sends an acknowledgement reply message to the local server.
6. The local server send the user the requested resource as soon at it receives the resources from the cloud system.

B. Resource Monitoring Procedure

In our architecture we are providing a facility of sharing the unused resources. Thus there must be a process to identify the unused resources. The procedure of resource identification is depicted in the figure 3 with a flow diagram.

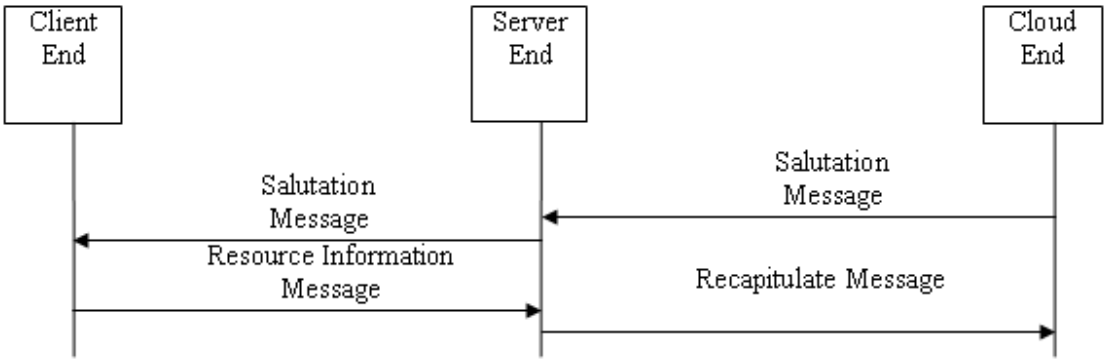

Figure-3: Flow Diagram of Sharing Resource Information

The cloud system sends a periodic salutation message to each server associated with an institute to find out the status of their respective clients. Each server replicates several copy of that salutation message and forwards each copy to the client under its domain. The server waits until it receives the Resource Information Message from all of its clients. When all the information from the client comes, the server generates a recapitulate message based on the information that it collects from the client end and send back the message to the cloud system.

C. Resource Allocation Procedure

The server collects the request from each client under its domain at a particular time interval. Thereafter the server summarizes the total requests by combining them according to the individual group of services. As for example if the server of an institute accepts two request from two distinct clients one with 10 GB of storage and one antivirus software and second one with 5 GB of storage along with an antivirus software and visual C++ software at a particular then it just summarizes the request with 15 GB of storage along with two Antivirus software and a visual C++ software. The cloud system as soon receiving the request from the server end it just send 15 GB of storage, images of the two antivirus software and the entire visual C++ software or the part of the software if necessary after a verification. The internal architecture of cloud central system is depicted in figure 4.

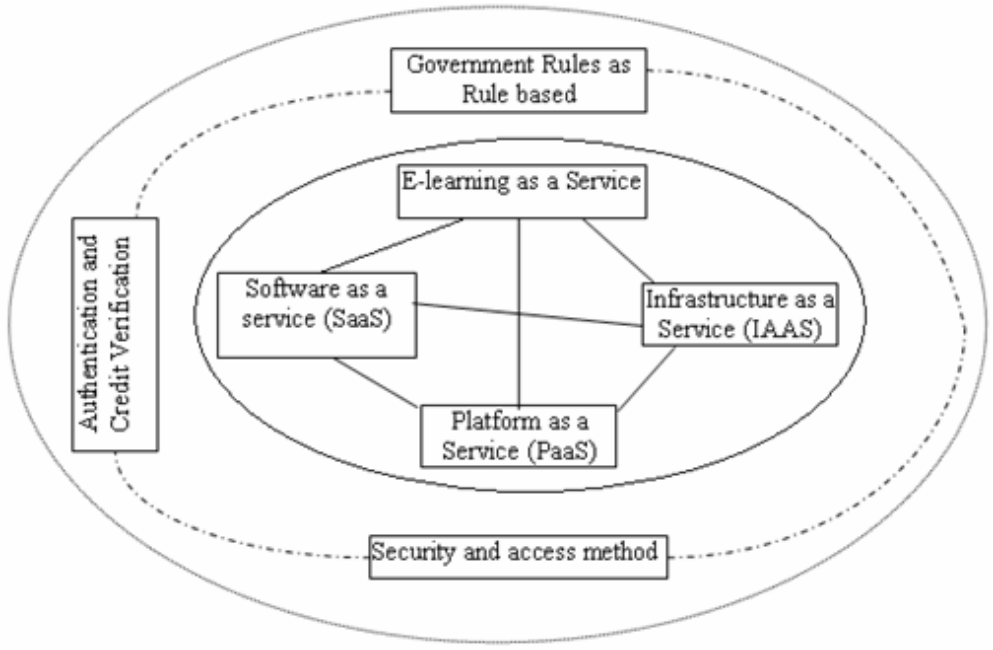

Figure-4: Cloud Central System Internal Architecture

The Architecture of Cloud Central System composed of two sub-layers. The upper sub-layer performs several operations prior to offer any service such as authentication, credit verification, scheduling and security. In addition there is a government central control system associated with the cloud upper sub-layer to monitor the operation of the cloud system. On the other hand the lower sub-layers basically offers four different types of services such as SAAS, PASS, IAAS or e-Learning tools as a service based on the user demands.

1) The Upper Sub-layer

Security is a massive issue in cloud system as the services are accessed over the internet. Since the individual client has the options to choose their own security methods like encryption process, cloud system has the agreement with local server to understand the security methods so that it can interpret them. As we mentioned that users at several levels constitute our educational system and therefore request for services are different for those diverse levels of users. Hence it is very important to maintain the access method by identifying the types of users and services. This sub-layer defines a policy of equilibrium between User and Provider by taking several factors into consideration such as user level, latency and throughput. According to the policy the government sets different priority for different levels of users so that the user with higher priority can access the resources with lower latency. The policy also ensures the provider to run the software smoothly with maximum throughput and highest load balance.

The Authentication and Credit Verification sub-layer associated with the upper sub-layer checks for the validity of the local server as soon as a request for resources is come from the server end. This sub-layer also verifies the user credit information for the requested service. If it finds that the user has sufficient balances for the requested services it accept the request as a valid one and transform the request to the lower sub-layer. As soon as the lower sub-layer confirms the request from its available resource pool it adjusts the user account after deducting the amount for the requested service.

There are two subsections associated with the Government Rules as Rule Based sub-layer of the architecture namely the planning and monitoring committee. The planning committee decides the prices for different types of services based on analysis and agreement with the cloud partners. It also decides how much funding needs to be allocated for individual organization. Normally several factors are considered when it allocates a specific amount of budget for a particular institute such as the level of education, student number, student quality, area of study and progression of that institute. Furthermore it can enhance the budget if it finds that the user is demanding more resources continuously through their submitted comments. The corruption monitoring committee monitors the daily proceedings of every institute. In addition it also observes the objections come from the user end. There are several types of objections that can be come from the user end such as the improper resource distribution, shortage of resources, inappropriate software or unmatched software etc. So the corruption committee is responsible for taking necessary initiatives to sort out the problem associated with the user end. The committee has also the power to take any action against the authority of the institute involving in corruptions.

2) The Lower Sub-layer

The lower part of the architecture gives access to the particular resources requested by the user. Once the upper layer sends positive acknowledgement to the lower layer it offers the particular services to the requested user. The Service Identification Panel associating with the lower layer identifies the particular service requested by each individual user. The cloud client-vendor-partner instrumental panel creates an interaction between the operations performed in the front-end and backend [9]. However, since the vendors can not operate autonomously without the help of their partners so instrumental panel's responsibility is to create interaction between cloud partners with the cloud vendors and clients [10]. The layer contains an Operational Panel, whose task is to monitoring the circumstances, handling the PCs and managing images. This panel contains a script based tools for constructing, configuring, monitoring, controlling and maintaining the clusters. This tool is known 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 virtual cloud system. However it is possible that the desired image that is already loaded in its xCAT system can not be found in any available real or virtual server. In such case it looks for any available server that fulfils the specifications depicted in that image and the xCAT system vigorously load that image. The implementation panel associated with the lower layer provides a distinct platform for the execution of the virtual software. It also ensures the deployment of the total virtual software or part of the software package effectively without installation on the operation surface. The exhibition panel supervises the instances of virtual exhibit and agglomerates the desktop windows. Since the execution of the software ensues the decentralized procedure on different physical or virtual machines so this panel ensures that users can interact with the presentation window of those de-centrally executed software.

IV. COMPARATIVE ANALYSIS OF PROPOSED CLOUD SYSTEM WITH THE EXISTING SYSTEM

A. Data Portability

Data portability is very important in educational sectors. Student does several projects and research works on diverse fields. Moreover they collect several materials associated with their study like lecture, slides and various supplementary documents. However, today security is a very big concern for everybody residing in a country. Hard drive failure is an ineluctable phenomenon in the contemporary endeavour. Most of the time the task done by the students destroy due to the computer virus attack, hardware failure or inefficient management of PC. The low economic country such as Bangladesh it is very hard to provide the expensive security related software or appoint experienced Lab administrators to take care of PCs efficiently on regular basis. In addition, since the lab PCs are open for all so some students coarsely handle the computer which results deletion of some important files. In the current system there is no concept of Backup storage. Therefore we are encountering some serious threats in the education sector. [11] shows that on average a unit data loss occurrence yields an institute or organization $2,900, the majority of which is considered as lost productivity. Although hard drive manufacturers assert less than a 1% failure rate, recent research by computer scientists at Carnegie Mellon University found that a 2%-4% failure rate is more widespread and under certain circumstances the failure rate tends to about 13% [12]. However in our proposed cloud computing architecture each institute has the opportunity to store their data in Cloud with the budget that is allocated for them. In addition, the cloud provides the users an unprecedented level of scaling without compromising on the performance and with a minimum service charge. This will definitely feel the students more relax and help our country economically as well from the loss due to the storage.

B. Overseeing and Reporting

The current education system has some serious drawbacks in case of overseeing and reporting. According to the survey performed by the Transparency International Bangladesh a significant inconsistency or flaws subsists which engender corruption in our country's basic education system [13]. Some of the teachers are not well qualified since there is no transparency in teacher's intake. Furthermore although government provides each institute a reasonable amount of fund for buying new and updated PCs but due to the upper level corruption the students are depriving from getting finesse resources for their study. In addition some organizations enforce the students to pay illegitimate fees for admission into schools, purchasing of books, sporting events, promotion to higher classes, entertainment purposes etc.

We find that since there is no way of monitoring these things centrally so we are confronting those problems. However in our proposed system there is a monitoring committee that is an integral part of the Government Rules as Rule Based. The committee observes the overall circumstances of each educational section. Any user can send any complain as well as any valuable suggestion into the cloud. Since the monitoring committee can observe each educational sectors performance centrally and instantaneously without physically going to that organization so everybody will now become more conscious before doing any corruption.

C. Economical Feasibility

Due to the poor economical condition the government can serve only few computers to each institute which is approximately 0.782 per 100 people [14]. Moreover the survey performed by the organization Amader Gram [15]

shows that the government can provide computer only 35% school out of its total school. However the fulfillment of software requirement is even more severe than hardware fulfillment. Since the Government can not afford the high price software for each institute therefore the use of pirated software is increasing day by day. It is often observed that the pirated software has lots of problems and does not give the exact performance what the legitimate one does. In addition the vendors are also depriving from getting there revenue due to the increasing use of pirated version of software. Since the current system does not have any concept of resource sharing so the government can not fulfill individual demand by supplying unique resource for each of them due to the low economic condition of the country. According to our survey we find that most of the institutes do not use their PCs for the 40% of the total working hour on an average. In our proposed architecture the cloud system has the knowledge of all unused resources and assigns resources from those free portions if any request arrives. In our designed architecture the partners associated with the cloud system offers software to the cloud for individual user with a reasonable price rate. The government can also buy the images of the software and distribute those images to each institute with a minimum amount of charge. This will reduce the cost of the software as in our proposed architecture we can avoid the third party involvement in software purchasing. On the other hand the providers will be also benefited since we can now use more legitimate version of the software for its low price rate.

D. Distance Learning Education and e-Learning Toolkits

Distance learning education provides opportunity to carry on a course of study while balancing other commitments. In our education system it is observed that there is a massive difference between the knowledge provides in urban area to that of rural one. In urban areas we find some serious flaws in number of teachers, the quality of teachers or the availability of various updated resources such as different e-Learning toolkits. Moreover some people stay and work in a distant area has little access to higher education or their responsibility to job prevent them from catching the scheduled lectures. Sometimes the course that someone intended to complete is available at a provider that is an inconvenient distance from where he lives. Thus the students completing their education in rural areas find themselves way behind in knowledge when they are facing interview for a job or thinking for higher studies. In our proposed architecture we are bindings all the areas ranging from urban to rural one into a single domain of cloud system and are facilitating every institute to collect the different materials related to their education by offering the e-Learning services. Since the government now offers those services with a very minimum charge so everybody including teacher to student will now improve their knowledge with those updated resources. This will definitely lessen the knowledge barrier between the students all over the country.

V. CONCLUSION

The primary intention of our proposed architecture is to use our limited resources in a most efficient way. Since we find that the resources remain unused for most of the time so we have introduced this architecture. Furthermore we can find some serious flaws in the management of resources as there is no central observation of resources for individual institute. In addition the widespread use of pirated software can be controlled using our proposed architecture. We have introduced four different types of services in this architecture. We believe that this architecture can provide an effective way to balance the resources with the current economical condition by utilization of unused resources and elimination of third party involvements and provide more secure environment since the client can also now configure his own security policy. Using a side by side analysis between the current educational structures with our proposed one we have demonstrated the benefits of our architecture in different perspective. Although our primary intention was to design architecture of education for Bangladesh's perspective but any developing country can use this architecture for their education system. In future we would introduce a prototypes system based on this architecture and would discuss the practical issues that may be encountered during practical implementation of our proposed Architecture.

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