

## **Efficient Thin-Client/Server Architecture for Educational Institutes**

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**Abstract**— As the technology changes over time Thin-client/Server architecture is becoming popular in single as well as multi user network architecture/Environment. Basically Thin-client architecture consists of user terminal which is connected to Remote server and user can login to the domain and run the programs. As we see the development in hardware and networking technology which result in virtualization or cloud computing, it makes Thin-client/Server architecture more effective w.r.t. cost, maintenance, administration, installation, power and security. This results in the increased use of Thin-client/Server architecture in various computer related education and institutes from last 4 to 5 years. So we propose an efficient architecture in an Institute for 250 users and 10 servers. We try to describe the various phases of this architecture.

**Keywords**— Cloud Computing, Thin-client Architecture virtualization.

### **I. INTRODUCTION**

Thin-client/Server architecture becomes very popular in the IT field now a day because of its various advantages like efficiency, cost also it is powerful efficient solution for various fields like education, finance, corporate world, health. For instance, various private public sectors are trying to use or implement the cloud computing architecture virtualization to be with the IT development field and this will improve the performance of Thin-client/Server architecture. Also Thin-client/Server architecture has various pros compared to Personal computer use or traditional computer architecture which is elaborated below for easy understanding.

It improves the computer system's efficiency at various institutions. In this architecture all data and software's are stored at the remote location on the dedicated servers over a network. Hence users all work and data is stored on the remote server over network and user has not local copy of the data. Thin-client has less hardware parts as the main components are at the server side so it has more life span as compared to desktop PC or personal computers. Updating the software is done remotely from the client side so no need to physically present at the server side. Because of this it is less vulnerable to the hardware parts. Also Thin-client has the standard user interface all over the institute so it is easy to user it. In addition to this recovery is very faster in case of system crash and lessens the need of technical assistance for any problem or recovery.

It is cost efficient information system architecture because they are cheaper, has less hardware parts and their life span is more. As main software updating process and data storage and backup is done at the remote server side it reduces the management and maintenance cost and make this task easier and efficient. In addition to this Thin-client has less hardware so power consumption is very less compared to personal computers or desktop computers.

Thin client improves the security of information and data because they are not having local disk and disk drives or removable media. Also they are less vulnerable to spywares and viruses. User has to store data at remote location on remote file server and if some critical data is needed then this data can be copied or moved to the portable media or portable disk storage. Using Thin-client/Server architecture over domain reduces the workload of system administration and make the task easier and reduces the system's internal threats with respect to traditional client server architecture in the institutes.

We can compare the Thin-client and personal computers by considering the above pros and advantages with respect to various points as given in below Table no 1 [1].

**Table 1. Comparison of Thin-client and Personal Computer**

Sr.	Property	Thin Client	Personal Computer
1.	OS	No need of Manual Installation	Need to install manually
2.	Updating Software	Only one time updation on remote server	Need to update each and every PC
3.	Drive Crash	No local drive so no data loss	Risk of local drive crash and data loss
4.	Recovery	One time remote system recovery if system crashes	Has to recover all system if crashed due to user use.
5.	Power Consumption	10 to 20 Watt	300 to 400 Watt
6.	Emulation Software	Need emulation software to connect to the server	No need of emulation software for connection.
7.	Technical Assistance	Less need of Technical Assistance as less hardware	Need frequent technical assistance.
8.	Physical Space required	Requires less physical space compared to PC	Requires more physical space.
9.	Cost	6000 to 10000 INR	12000 to 16000 INR

The cost analysis can be calculated as shown in following Table 2 [1].

**Table 2. Comparison of Thin-Client & Personal Computer against cost**

Sr.	Criteria	Thin Client	Personal Computer	Saving (INR)
1.	Cost	23000	43000	20000
2.	Hardware Upgrade	---	21000	21000
3.	Software	---	17000	17000
4.	Antivirus	---	2000	2000
5.	Upgrade Maintenance	---	17000	17000
6.	Technical Staff per 100 Users	4000	10000	6000
7.	Data backup & Maintenance	---	13000	13000
8.	Power Consumption(w/h)	14000	20000	6000
Total Savings per client (5 yrs.)				102000

From above comparison we can conclude that:

- Using thin client instead of Personal Computer saves 102000 Rupees after 5 years.
- In middle size unit using 100 Thin clients instead of PC saves 10200000 in total.

## II. LITERATURE SURVEY

Thin-client/Server architecture has a noticeable advantage in terms of power consumption (Energy Calculator for PC Equipment). Thin clients reduce power usage by 24% and carbon dioxide emission by 23% and improves the life span by five to ten years. By replacing desktops by thin clients, nearly two-thirds of the power consumption can be reduced [2].

Thin client / server architecture is used by educational institutions as they allow students to analyze real data in their research without modifying or removing data either deliberately or unconsciously [3].

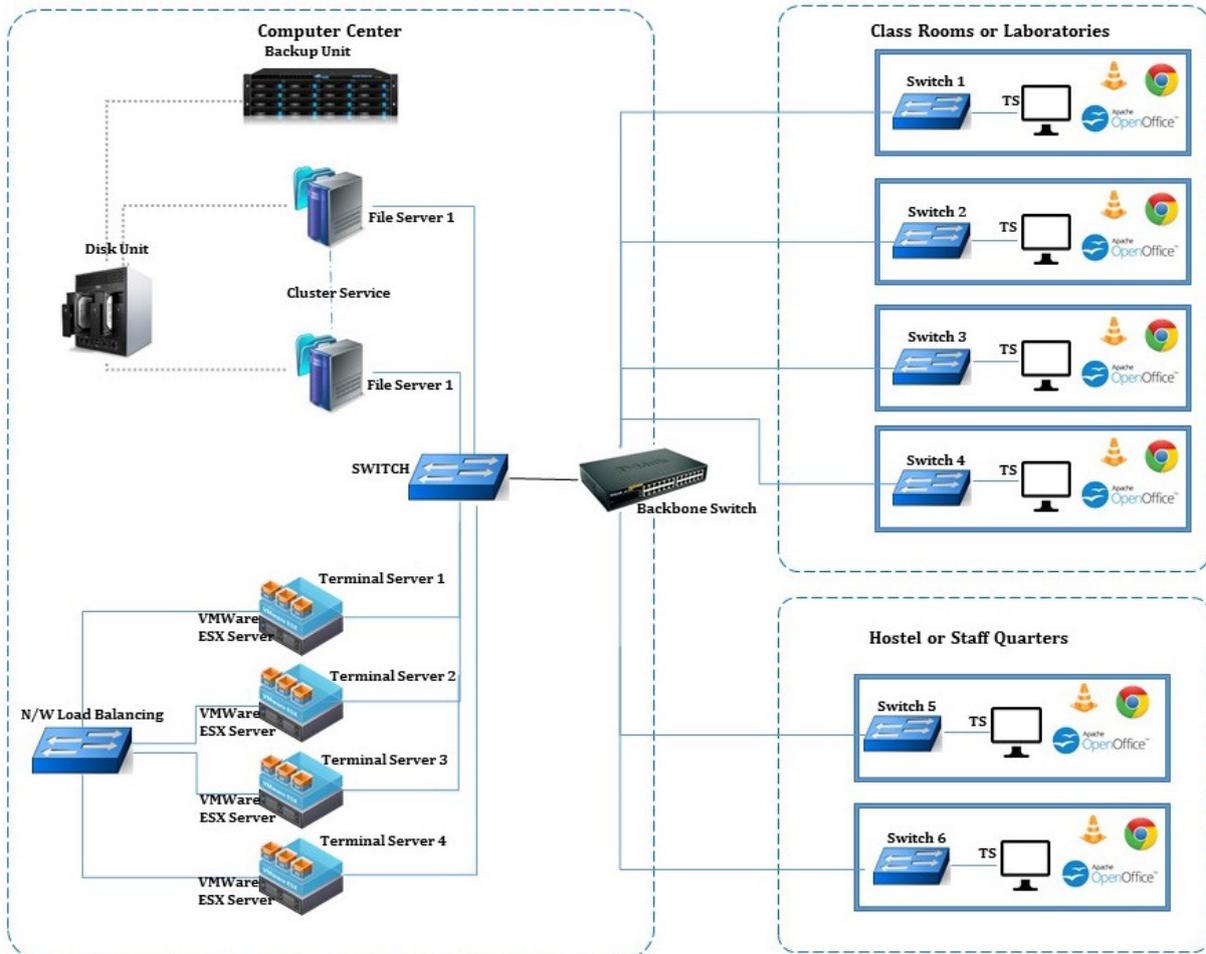
Also, this architecture disallows unauthorized access to critical data from outside the institution. Moreover, computer-aided education has overlapping characteristics with thin client / server architecture in terms of multiple usage of digital resources and cost-effectiveness [4].

There are a various benefits of cloud computing in education and advantages in cost for improving the quality of system in terms of Total Cost [5]. These various benefits are like providing

educational resource storage and databases, educational applications, e-mails and tools for students and staff also clients all over the world. This encourages the use of thin clients in several implementation areas and has renewed people's interest in the thin client concept [6].

### III. IMPLEMENTATION

To design Thin-client/Server architecture having approximately 1000 students and 500 staff, for testing purpose we can install 250 thin clients in total among them 40 are reserved for staff and 210 for students. Also we can install 2 file servers & 8 terminal server. This implementation is shown in following figure 1 [1].



*Figure 1. Thin-client/Server Architecture.*

We use thin clients (ASTC TA-1381) and terminal/file servers (IBM X3650-M3). For virtualization we can use VMware ESXi 4.5 software on terminal servers. We can install Windows 2008 R2 Enterprise OS on the servers. Also, we can install Open Office, Nitro PDF Reader, WinZip, Picasa, Chrome, VLC media player, Notepad++, Eclipse, Turbo C++ & Java (jdk) software programs on the terminal servers that can be used by the users from the thin client.

While considering the storage for students to save the work done by them we can allocate 1Gb data storage on the file server for each student. Also we can define nomadic profiles for the students so that they can define and use personal settings (desktop settings, personalization, shortcuts, program settings, etc.) on different thin clients.

We can define 2 different server profiles for each terminal server with the usage of VMware ESXi virtualization software. The first one is for students and another for staff. Different settings and

software programs on two virtual terminal server are available. Two different setting for hardware use can be defined on two servers at different times during the day. For example, we reserve more hardware capacity for staff during working hours because at that time students are having the lectures or classes and vice versa.

#### IV. CONCLUSION

In this paper, we present an architecture for educational institute in which we proposed 250 thin clients for students and staff. The increase of bandwidth usage represents the effectiveness of this new architecture. Students and staff has access to their data from several places like hostel, laboratories, library, classrooms etc. Also they have the same interface and settings because of nomadic profile. New software's required for educational purpose can be installed easily on the small number of servers. Also resources can be managed by the virtualization technologies so that, all users (staff as well as students) can use thin clients more efficiently. We can have low maintenance labor for hardware/software problems on the client side.

One of the important characteristics is that thin-client has less power consumption, which is nearly 10% of personal computers. This can result in the low total cost as well as to reduce environmental effect. It represents the social responsibility of the human beings against the environment and global warming. So we conclude that, the usage of thin client / server architecture will become extensive and popular in various Educational Institutes.

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