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A Secure Cloud Server Using Raspberry Pi and Kerberos Authentication Protocol

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***Abstract*—** An internet based computing where number of servers situated remotely are inter-connected to each other and access to some services are allowed online is framed as Cloud Computing. But the existing systems require very expensive hardware and the power consumption is also high. Also the existing systems are quite complex and usually require larger area to install along with high maintenance cost. So the idea is to propose a system where users can store their data over the cloud and retrieve their data from any part of the world. The proposed system not only provides reliable file storage but also provides high security. This proposed system uses Raspberry Pi which is a single-board computer; small in size to develop a cloud server which will be secured as well as less expensive. For security, the proposed system uses Kerberos authentication protocol which will act as a third-party service that will be used to authenticate the user's identity. It will act as a bridge between the user and the cloud storage.

***Keywords*—** Raspberry Pi, Kerberos Authentication protocol, Cloud Server, Security, Client Server Authentication

I. INTRODUCTION

Among the newly introduced technologies, one of the highly emerging technologies is Cloud Computing which is abundantly used for remote data storage and its availability. The Cloud technology is still in its developing stage, despite of numerous research and development on it, the subject is still in its commencement.

The existing cloud system provides storage space but with high cost to service it. There are different types of issues that are faced when cloud based services are taken into consideration. These issues can be broadly divided into 2 types: Issues faced by the users who use these services and issues faced by the providers who provide the cloud services. A recent survey created by the Cloud Service Alliance reports that the threat to cloud computing comes on third on the list. Looking up to that, the companies must be provide a security check to their data centers where the data is being stored. Also these DC's must be regularly monitored for some skeptical activity. The recent introduction of the Raspberry Pi, a low-cost, low-power single-board computer, has made the construction of a miniature Cloud DCs more affordable [1]. The proposed system will incur low cost because we are going to use a Raspberry Pi. Also to overcome some of the security issues the system will use the concept of Kerberos.

A typical Cloud DC usually contains tens of thousands of servers, making it prohibitively expensive for an educational or research institution to construct one. Even a practical testbed consisting of a reasonable number of servers (say, 40 machines) can still be out of the reach of most researchers when one needs to consider space, power and cooling infrastructure [2].

The idea of the proposed system is to provide a cloud server which will have low hardware cost, low maintenance cost and will also be compact. As the present cloud servers are very large in size, expensive, maintenance cost is high and also requires high expert supervision.

The system uses Raspberry Pi to serve the purpose. The proposed system tries to provide the same utilities of the Cloud Data Centres' using scaled components. The Raspberry Pi is a single-board computer created by the Raspberry Pi Foundation, a charity formed with the primary purpose of reintroducing low-level computer skills to children in the UK.

The aim was to rekindle the microcomputer revolution from the 1980s, which produced a whole generation of skilled programmers [3].

II. PROPOSED SYSTEM

The combination of all the 3 entities in the proposed system helps a client to access his data from a secured cloud server which uses Raspberry Pi and Kerberos as the authentication protocol. Kerberos is a distributed authentication service that allows a process (a client), running on behalf of a principal (a user), to prove its identity to a verifier (an application server, or just server) without sending data across the network that might allow an attacker or the verifier to subsequently impersonate the principal. Kerberos optionally provides integrity and confidentiality for data sent between the client and server [4].

The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. It's capable of doing everything you'd expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games [5].

A. *Overview of the proposed system*

The overview diagram of the proposed system is given as follows:

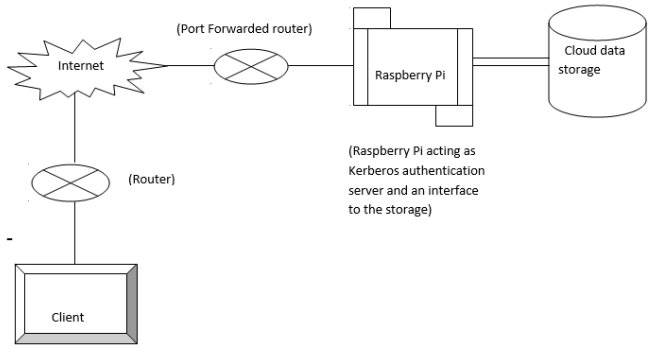

Fig. 2.1 Overview of the Proposed System

The different entities and their respective roles in the proposed system are given as follows:

1) *Client:*

A client is the end user who uses the system application. It should have a stable internet connection to connect with the cloud storage and access its data from the cloud. It uses a router which helps it to connect to the internet. A client has access to the cloud and downloads and uploads content to the cloud with the help of a secure login.

2) *Raspberry Pi:*

The stage two consists of the Raspberry Pi. As the client tries to access the cloud storage, the request is passed through the Raspberry Pi. The Raspberry Pi acts as an authentication server and security gateway to the cloud storage. It uses Kerberos protocol to provide authentication. The Raspberry Pi can run various versions of the Linux operating system as well as other operating systems, such as FreeBSD and the software and tools associated with development on it. This allows us to implement the types of technology found in Beowulf clusters and other parallel systems [6].

3) *Cloud Data Storage:*

Once the authentication process is completed, the client is allowed to access his data from the cloud storage. The cloud storage consists of large storage devices which have large amount of free spaces. These free spaces are allotted to the client to store their data. The client can authenticate themselves, and can use the services of the cloud storage to manage their data. Kerberos in cloud data storage can reduce the client key input frequency effectively, and avoid the transmission of user key on the network and enhance the system security [7].

B. *Communication Diagram*

The overall working of the system is explained in the communication diagram. The fig 3.1 shows the communication diagram of the system.

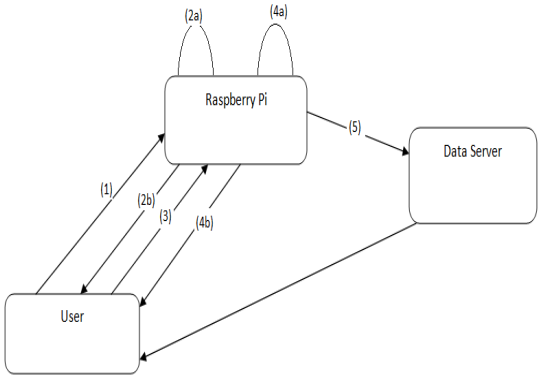

Fig. 2.2: Communication of the system

C. *Flow Chart*

The fig 2.3 shows the flow chart of the proposed system.

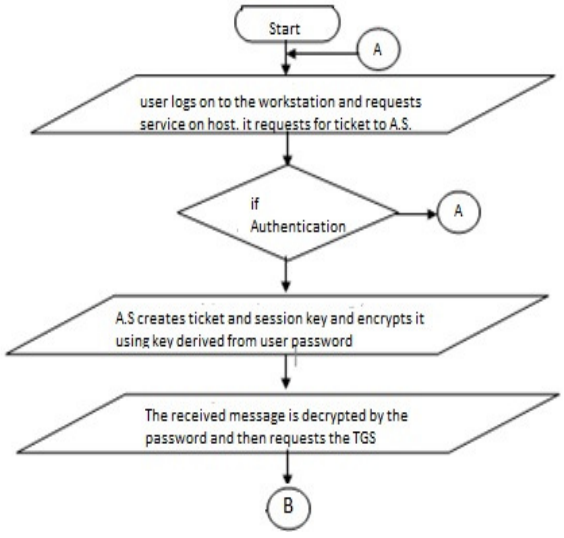

Fig. 2.4: Flow chart of the system

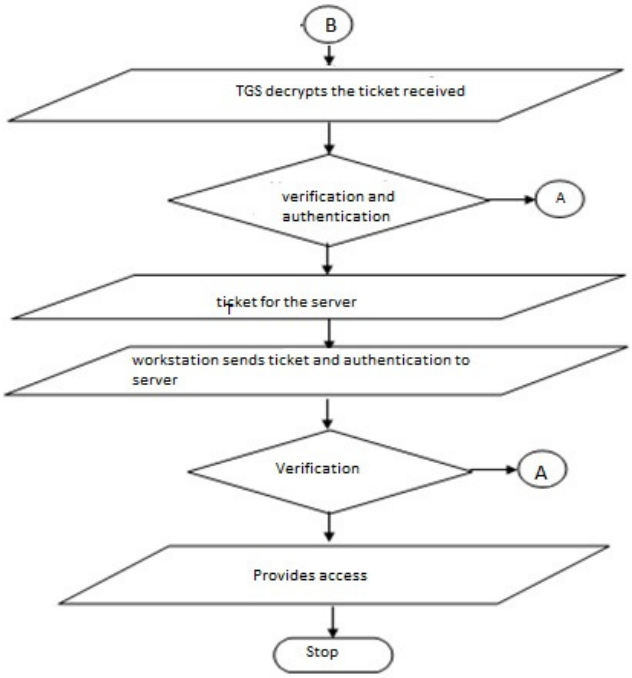

Fig. 2.4: Flow chart of the system

There is a need to develop a system where users can store their data over the cloud. A user can retrieve their data from any part of the world. Reliable file storage and high security are provided by the system. One of the feasible options is to use a Raspberry pi.

III. RESULT

Table a. illustrates the cost breakdown for constructing a 56-machine testbed with commodity x86 servers and Raspberry Pi devices, respectively .The cost of the CloudPi is several orders of magnitude smaller than that of commercial servers. If the goal is to carry out intensive computation, then clearly the CloudPi is no substitute for x86 boxes.

a. Cost breakdown of a testbed consisting 5 servers

	Server	**Power**	**Cooling ?**	**Needs Security?**
Test bed	₹5,00,000 (@ ₹ 1,00,000)	900W/h (@180 W/h)	Yes	Medium
Cloud Pi	₹67,500 (@ ₹ 2,700)	17.5W/h (@3.5W/ h)	No	Advanced (Kerberos)

However, if our goal is to replicate the architecture of a Cloud DC, then the CloudPi offers a very economic alternative. Furthermore, due to the lightweight nature of the Raspberry Pi both in size and in power consumption, it can be hosted without extensive physical footprint or expensive power and cooling management, which reportedly accounts for 33% of the total power consumption in Cloud DCs.

IV. CONCLUSION AND FUTURE SCOPE

This is a system where users can store their data over the cloud. A user can retrieve their data from any part of the world. Reliable file storage and high security are provided by the system. One of the feasible options is to use a Raspberry pi. The proposed system aims at reducing the cost of hardware, complexity, space issues through the Raspberry Pi providing user with secure cloud service. The users will get to access a secure cloud. It will be handy software to upload and download content from any part of the globe and most importantly, the content will be secure as well.

Raspberry Pi can be connected in a cluster of many Pi's and prepare cloud storage at a large scale. The Raspberry Pi cloud server system will be of great advantage to users looking for low cost servers. Make the application affordable to every common man by a very large scale production. Furthermore to enhance the authenticity of the user an improved version of Kerberos which implements Deffie-Hellman algorithm can be used for key exchange. It realizes that the user is able to use the authorized service function with the ticket distributed by Kerberos authentication center during a certain period after the users log on successfully once.

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