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A Great Approach for Medium Size Hospital Network Infrastructure Architecture

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Abstract: ***To get first-hand experience for setting up a network infrastructure in a medium size hospital to manage the patient's services, check-ups, follow-up plans from different parts of the hospital primes and store the data into the secured and safe manner in the database and use the data whenever required from the management team for their references. The network architecture based on the concept of the Three- layer network architecture combination of Mesh topology & Bus topology taking into the consideration of the primary data security, remote access to the network, size of the hospital organization, cost-effective, user-friendly and most importantly scalability required in the network architecture for future changes based on the size of the database, utilization of applications remotely, and for security of the data, changing technology etc. The goal of any network architecture is to protect the DATA from any attacks both internally and externally. For internal DATA security it is protected through various user permissions in different layers in the network for the end users. For Outside threat VPN tunnel, Policies, traffic filtering configured at the firewall level.***

Keywords: HIS-Hospital Information System, VPN- virtual private network tunnel, VLAN- Virtual LAN, HL7- Health Level Seven International, L3- Layer 3, ISP- Internet service provider.

I. INTRODUCTION

Because of this computer era, medical institutions all over the world are implementing hospital information system (HIS) technology rapidly; the requirement for a centralized database for data security and secure way to access it is the most priority for every organization. In today's world high speed Internet technology can ease remote access and Doctor's can easily access the patient data (based on the AAA model authentication, authorization, accountability from their individual organization) from anywhere in the world, and prescribed them remotely itself in case of emergency and also for the distribution of medical data to the medical community for case references. HIS concept is a combination of software and hardware devices. As all the patient data kept in the database in HIS model concept for case references data finding is very easy as compared to the manual file system for every patient. Every single data stored in HIS module digitally, which increases the efficiency of the organization as well as time saving.

II. OBJECTIVES

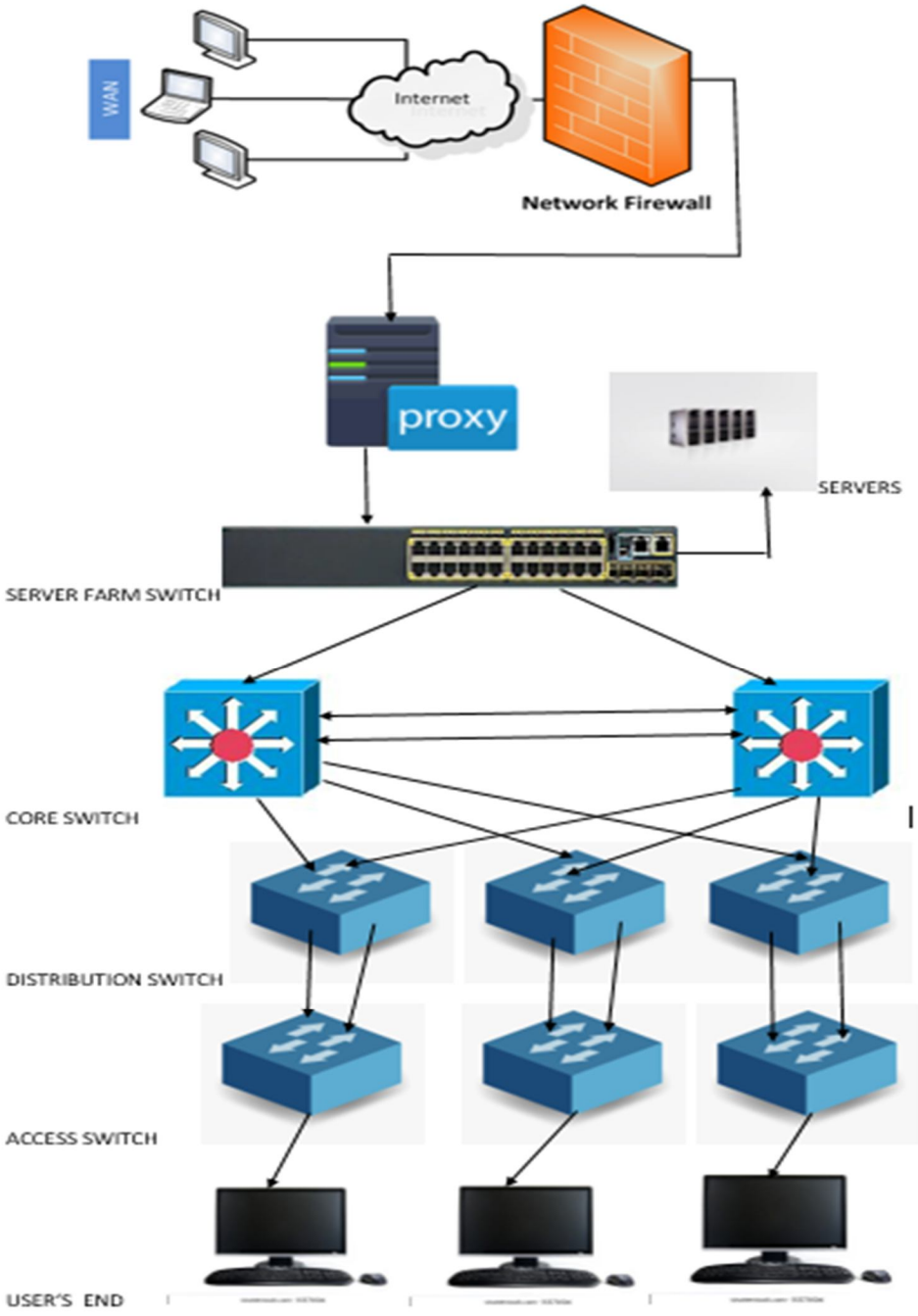
In the past years, more and more healthcare institutions have switched to HIS integrated information systems from the old manual (physical register maintain system)to manage all the administrative, financial and clinical documents of a hospital. This development began when the need for competent resource management, high availability and security of information had become critical. These types of infrastructure have been implemented with success in various medical institutions, but the health system has yet to adopt a standard solution, In many cases still many health systems use different medical information systems from third party vendor's which are usually mismatched. The need for the centralized structure required for the integration of the HL7, retrieval of data, digitalized documentation from clinicians, old patient data search digitally within a second as compared to too much time spent searching a physical file manually.

This system can help to share of information digitally within the network, because of the patient case history is present digitally within the network joint clinical meeting of Doctor's for some patients can be done in HIS module itself for that patient may not require presenting physically, improve patient doctor relationship, care provision and offer time, cost savings and convenience. The distribution of information between hospitals, clinics and private practices enables better treatment administration, thus improving patient care. Another vital factor is the financial aspect, and by having a precise patient medical history, cost can be reduced. For example, this can be attained by not having to repeat certain tests of which records have been misplaced and thus dipping costs of patient's. This paper presents a procedure to approach laying a network that permits hospitals to manage and have access to databases remotely.

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III. HIS ARCHITECTURE

In response to the above said healthcare system's needs we advise an essential resource distribution system, targeting those affected at a national level. This architecture will ensure secure communications, remote access for users and personnel management. As a proof of concept the architecture (Fig. 1) is planned in such a way that it can be simply united in any present structure and its scalability structures being heavily taken into attention.



(Fig – 1)

The above-mentioned network architecture is based on the concept of the Three- layer network architecture combination of Mesh topology & Bus topology, so the network components have been divided into three major structural segments: Core level, Distribution level & Access level. And above core level Server farm and security appliances have been positioned.

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IV. HIS COMPONENTS OR PRE REQUISITE REQUIRED:

Each structural component has a specific purpose and topology, the communication between them being done through standardized logical interfaces. The client component has a campus network topology, helping a large access network, each of the end terminals having particular software running. Through the graphical user interface of this software, access to medical resources is allowed based on user permissions. The resources are placed at the server end.

As shown in the diagram (Fig – 1) ISP is connected to the Hospital firewall. Firewall is used to protect Local users from the Outside unwanted user threats. Firewall needs to be used in any organization to filter the packets, creating VPN tunnels for the remote users access, creating policies which will be useful to protect the inside network from the outside threats. Network Firewall is a wall between LAN(Local area network) and the Internet (Outside world). Beneath Firewall Proxy appliance placed for the web content filtering. Proxy appliance used in any network for the user specific Website filtering. Unwanted websites example (shopping websites, social media websites, Job search websites etc) will be blocked in hospital organizations for unwanted use. Only Useful websites for doctors and other staff can be accessed based on the hospital policy. Because of the Proxy appliance bandwidth consumption in the organization is very minimized. Most of the malware virus users generally download it from the unwanted websites because of the proxy server it can be prevented as much as possible.

Server- farm switch is placed below the proxy appliance. In the server farm switch all the servers AD Server, DNS server, Application server, Database server, web server are connected which are used to manage users and structure and data type. Active directory provides a central management system for system administration via Group policy delegation to domain users. Application servers are used to run the applications centralized from different parts of the hospital premises. Database server is the fundamental component of any data center in the world. The key goal of this database is to store patient information, accounts information, medical history and insurance plans. Database servers store highly patient information, for example patient evolution, diagnostics, surgical procedures, patient clinical information, radiation information, smartcard amount information etc. We must understand the fact that a central database system in any organization will store each and every data for the patients and whenever the end user is required to extract some data as per their criteria they can get it from the front end via an application server. The database also eases the practice of statistical analysis of patients' illness incidences, researchers having the option to access the patient information as per their criteria in a structured manner.

For end users to use the application server, to use the proxy server for the internet, to store and retrieve the data from the database high end network connectivity required in the hospital premises. As per the Network Architecture diagram in Fig 1 network layer bifurcated into three major segments Core level, Distribution level, Access level. Core switches are generally placed in two different parts in the hospital premises one in the Data centre and another in other parts of the hospital premises. Generally hospital buildings generally have a minimum of two or three building blocks. So for redundant networks both the core switch will connect to each other as per the Fig 1 diagram. A core switch is not a normal kind of network switch. A core switch is placed in any network in such a way that it will work as a backbone of the network. A core switch is a high capacity switch that is basically a gateway between the Local area users and the internet. Core switch's main fundamental role is routing and forwarding. A core switch is much more reliable and higher throughput compared to other network switches. A Distribution switch is nothing but a building linking switch. For travelling a packet from Point A to Point B is maximum 100 meter. So in any organization for interconnecting two – three buildings we required distribution switches. Communication between the Core switches & distribution switches are in Mesh topology. Because of the distances between the buildings we use Optical fiber connectivity between the core and distribution switches. In any medium size organization because of the cost generally used to put two or three core switches but can have multiple distribution switches. Generally Distribution switches are L3 switches inter VLAN routing can perform in distribution switches An Access switch is directly connected to all the Host in any organization. Access switches are usually L2 switches. VLAN creation is generally done in Access switch. All the host in any organization have connected in the access switch to communicate in the network.

V. CONCLUSIONS

During the implementation of the architecture a few factors have been taken into account, such as scalability, the option to integrate with other existing networks, remote and secure resource access.

Scalability is essential in direction for the system to adapt to any health institutions. As the system starts to adopt widely, the large amount of data has to remain available without any downtime on the server site. This is attained through load balancing and redundant techniques in the server. One of the most important things in this architecture is that in future any additional devices that need to be added in this structure can easily be added into it. Given the fact that the architecture is flexible, integration is possible without changing the applied communication mechanisms.

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Most important objective is complete data security. That can be achieved in two way procedures. The first one was the inside security, being implemented through user permissions, endpoint protection. The second one is the attacks that originated from the outside of the network. To prevent system malware attack or data interception VPN tunnels and traffic filters were configured at the Firewall end. Most important factor in this architecture is the client application. The user interface through which an end user will communicate with the database server, application server is very user friendly with a high speed network. With this architecture researchers in the hospital organization can do their statistical research.

In conclusion, we can say that this architecture is an appropriate replacement for the current health system's data acquisition, storage and manipulation. This architecture can facilitate better health care facilities because of a negligible amount of time for the end users.

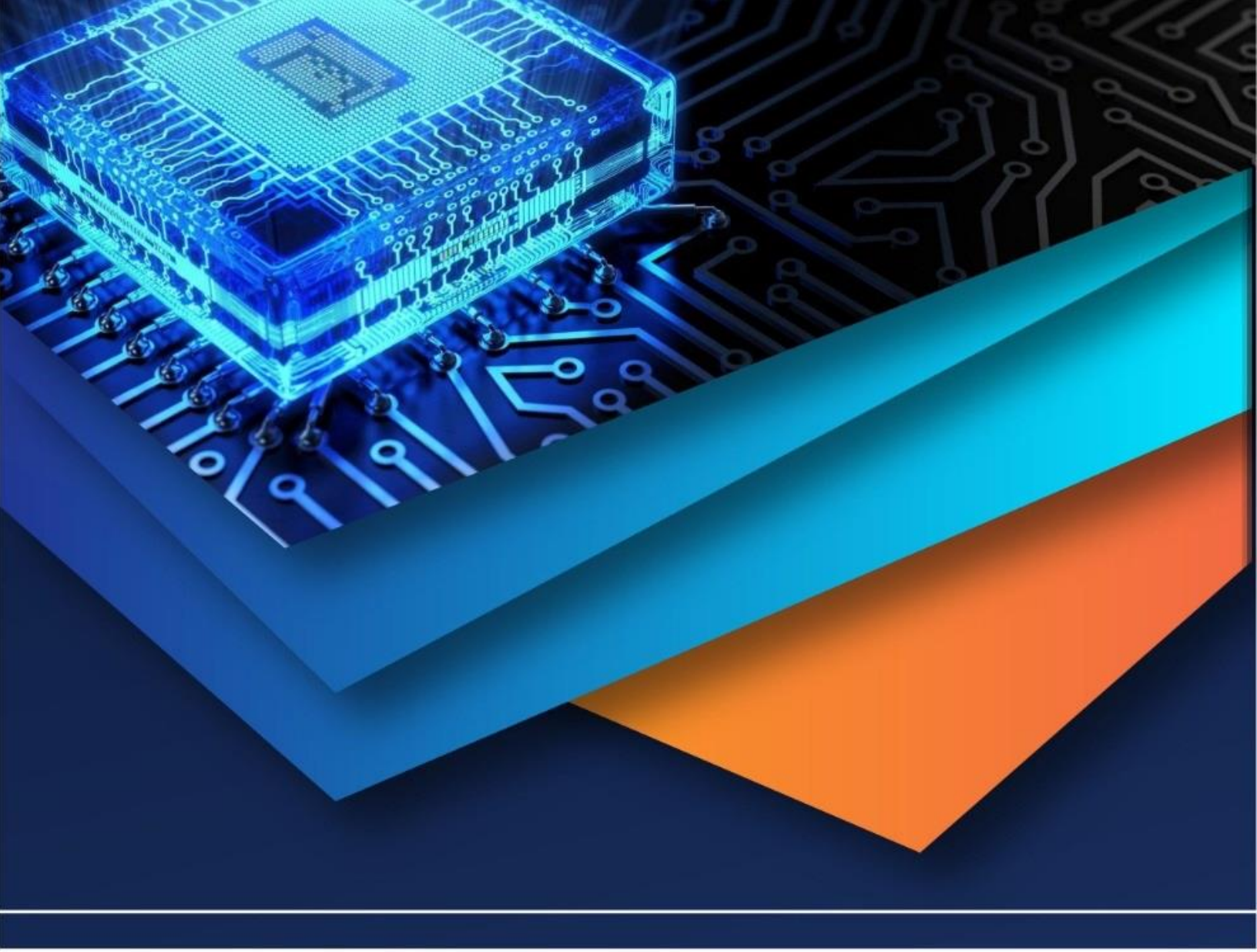
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