Deployment of secure network for VIVID Medical Center based on MPLS links

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ABSTRACT

Vivid Medical Center is one of the leading medical centers in Al Batinah Governorate in the city of Saham, which provides world-class healthcare services along with disease prevention awareness measures. This medical centers is composed of serval administrative departments covering different health specialties. The existing network of the medical center do not provide network coverage, and network connectivity among all departments which lead to delay in processing of patient data. This paper is aimed to rebuild entire network for health center by deploying and implementing various network equipment's including switches, routers and servers within different building to ensure that network coverage network connectivity, and low congestion without any disruption. In addition, this paper also look to enhance the network security by deploying encrypted communications to countermeasure both internal and external security threats that appears within certain operations.

Introduction

VIVID Medical Center is one of the leading medical center in Al-Batinah governorate in Saham city. It a healthcare vertical of vivid hospital LLC working to deliver excellent healthcare. It offers numerous specialties and super specialties to satisfy Oman citizens with the most advanced approach. It has advanced technology, comfortable place, quality equipment and friendly staff that distinguish it from other medial canter at same area. The main business of the medical center is to provide early perception and awareness over preventing disease through early diagnosis. In addition as any medical center, it has different departments. Here in VIVID Medical Center has 14 medical departments, which are Accident and Emergency, Nutrition and Dietetics, Cardiology, Pediatrics, Diagnostic Imaging, Cosmetic Care, Orthopedics, Pharmacy, Dental Care, Gynecology, ENT, Pain Management, Dermatologist and Ophthalmology. Where about five administrative departments are management, human resource, finance, marketing, security and reception (About Us, 2020).

Accordingly, the total number of both medical and administrative departments are 20 departments. In fact, there is no branch for this medical center, due to it is a new medical center and it opened in September 2020. It consist of seven floors with ground floors so, in total eight floors that involve the 20 departments. About the employees, there only 13 employees in administration departments where 28 doctors and 40 nurses. Therefore, the total number of employees is 81 employees. They have a local area network that it consist of only one router, two switches, one server and 10 computers. The computes distributed only in administration departments. Where no commuters obtained to doctors. Therefore, they employ the normal security that supported by router. The type of network wired network.

Literature Review

Data networks and network availability are among the basics that must be present in any organization in order to carry out business, regardless of whether it is small or large. Everyone needs networks in order to complete business with applications and advantages that excuse them in maintaining the work of companies. This is in order to achieve the goals of the institutions in their field of work. With the increasing and accelerating development, networks have become one of the basics that must be built in an excellent manner, due to the importance of the work they perform in order to facilitate and achieve the goals of institutions to work efficiently and effectively in the completion of their work. Where the economy depends on the Internet. That is, it is linked to customers in their contact with institutions

without interruption. Therefore, this makes it important for networks to be 100% available. Because of the great importance of networks, companies and institutions have embraced the importance of establishing and building an integrated network between all their departments, whether inside or outside the company. Accordingly, there are many steps that must be followed before embarking on building the network (SUOMALAINEN and VIRO, 2019). In fact, large institutions are the product of years of work, meaning that they did not appear by chance. It is the result of hard work. Accordingly, this indicates the compatibility of their choices in the interest of the institution in addressing business issues. There are several methods associated with organized planning when starting to build a network, as follows: (Introducing Network Design Concepts, 2020):

- Stage 1. Ensure of objectives of the business and specialized necessities.
- Stage 2. Elect and highlights the capacities that is needed to shows the problems recognized in pervious step.
- Stage 3. Play out an organization status appraisal.
- Stage 4. Generate an answer and site acknowledgment test plan.
- Stage 5. Make plan of the project.

After the organization necessities have been distinguished, the means of planning a decent organization are followed as the task execution pushes ahead. Organization clients mostly do not think as far as the multifaceted nature of the basic organization. They consider the organization an approach to get to the applications they need when they need them. Most organizations really have a couple of prerequisites for their network. Moreover, this project will meet the project objectives (Introducing Network Design Concepts, 2020). Security is an important aspect of all networks (Fang et al., 2010).

Today associations are spread across the globe because of higher business exercises. The organization availability among the workplaces at various geographic areas has become a test for network experts. MPLS is a moderately more up to date WAN innovation giving preferences over different advances. Simultaneously, it is viable with existing innovations like ATM, FR, Ethernet, and SONET. In this venture, secure organization based MPLS is executed in a professional workplace. One local office of an association is associated with the focal site through MPLS based ISP's organization. Center and talked geography is actualized in this situation. The network among the destinations is set up and sending choices are made based on MPLS marks rather than IP addresses. Besides, it is additionally detectable in outcomes that MPLS need not bother with some other burrowing convention dissimilar to other customary association joins like VPNs. It makes burrows dependent on names. Concerning the security necessities, it conceals the client's organization from the ISP's organization, which is talked about in the outcomes area. Multi-Protocol Label Switching (MPLS) is a generally new WAN innovation that is pulling in systems administration experts around the world. Numerous ISPs have just sent it to their organization. However, some other ISPs are in the pipeline to convey it. In any case, it has grabbed the eye of experts not long after it was created in around 2000 (Ahmed, Abedin Butt and Siddiqui, 2016).

The outline of this chapter is breaking down in to three main parts, which are similar work, that identify up to five applications that similar to project topic and application the second part is reviewing literature that include up to five other research papers that provide analysis of them. Also, supported with reason behind choosing theses literature review. The last part is the feasibility analysis that explaining meaning of each type of them and reflected in term of actual project.

Methodology

Alchaal, (2005) argued that expanded utilization of the worldwide Internet and IP-based applications have prepared for specialist co-ops to offer new arrange administrations to their clients. The media communications world reflects and typifies a crucial move in how specialist organizations work together without relying upon ISP center organizations that offer help arranged organizations that groups esteem added administrations on top of transport administrations. Additionally, as organization administrations become progressively perplexing and network-serious, clients need to tap the rethinking capability of specialist co-op administrations for cost investment funds. Accordingly,

to offer well-informed network administrations, specialist co-ops. It would tested to send their administrations by open organizations such as the Internet and elevated through changes in business client organizations. They presented a CE-based VPN approach, which offers diverse administration network administrations for the benefit of clients.

This methodology moves the administration bother from the client's side to the VPN specialist organization. However, through utilizing this methodology specialist organization have just to think about dealing with clients' edge gadgets, which are the entryways to the clients' organizations. This methodology is a concentrated arrangement, where a solitary Management Operation Point (MOP) heavily influences everything, including VPN creation, organization, and enrollment of the board. This proposal centers around three key viewpoints: the executives, dynamism, and security. We likewise explore the utilization of our way to deal with offer gathering correspondence administrations (for example Multicast administration) and to oversee and make sure about web administrations, yet different fields of uses are conceivable, as the dynamic administration of firewalls or VoIP. Hernandez and Jimenez, (2018) shows the cycle of undertaking advancement named Design and approval of the Infrastructure Servers in the University Institution - ITSA, that demonstrating was created for a few significant organization administrations, for example, Mail, Active Directory, Web, database, DHCP and DNS. This undertaking builds up a progression of proposals dependent on the presentation of a few tests that means to help improve the exhibition of existing innovation foundation and the association of organization data. The particular prerequisites were gathered to plan and build up an ideal answer for client control, the association of dynamic index, concentrated DHCP administration on servers, and approval excess of certain significant administrations network worker level. The current consistent geography of the dynamic registry was distinguished and diagrammed and a layout of the new wanted structure of the equivalent was made, containing subdomains for every site following the rules set up in the lifecycle of Cisco (PPDIOO)
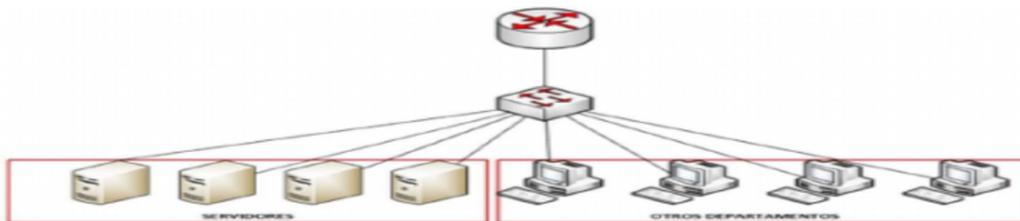
Figure 1: The topology utilized in the operation and other departments

Alabady, (2009) plan and execution of an organization security model were introduced, utilizing switches and firewalls. Additionally, this paper was led the organization security shortcoming in switch and firewall network gadgets, the kind of dangers and reactions to those dangers, and the technique to forestall the assaults and programmers to get to the organization. Additionally, he gives an agenda to use in assessing whether an organization is clinging to best practices in organization security and information secrecy. The primary point of this exploration is to shield the organization from weaknesses, dangers, assaults, design weaknesses, and security strategy weaknesses.

Kadry and Khaled, (2008) care about data frameworks security are which a portion of their data should be ensured against unapproved divulgence for legitimate and serious reasons; the entirety of the data they store and allude to should be secured against coincidental or conscious change and should be accessible in a convenient style. They should likewise build up and keep up the genuineness of the records they make, send, and get. Finally, if helpless security rehearses permit harm to our frameworks, they might be dependent upon criminal or common lawful procedures; if their carelessness permits outsiders to be hurt by means of our undermined frameworks, there might be considerably more extreme lawful issues. Another issue that is arising in web-based business is that acceptable security could finally viewed as a component of the market improvement methodology. Customers have communicated broad worries over protection and the wellbeing of their information; organizations with solid security can use their venture to build the pool of willing purchasers and to expand their piece of the overall industry. We presently do not require taking a gander at security absolutely as misfortune shirking: in the present commercial center, great security turns

into an upper hand that could contribute straightforwardly to income figures and the primary concern. Organizations today run crucial business benefits that need assurance from both outside and interior dangers. They proposed a safe plan and execution of an organization and framework utilizing a Windows climate.
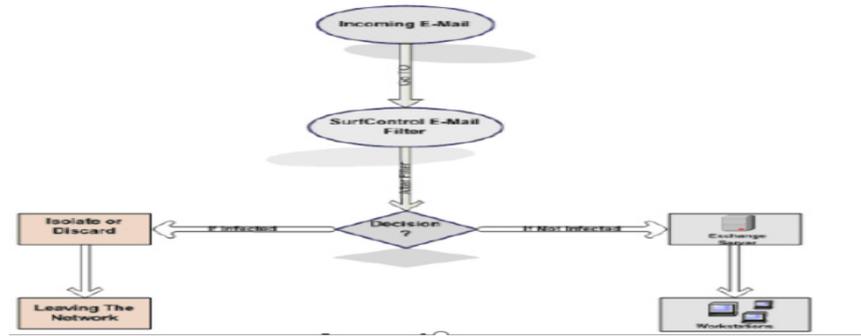
Figure 2: SurfControl Protection

MPLS (Multi-Protocol Label Switching) is considered a recent technology. Prior to its presentation, Service suppliers bore the weight of offering types of assistance to clients utilizing technologies of VPN, Layer 2, and IP routing. It was invited through everyone, is currently the accepted innovation utilized in big data centers, and services providers. It is an innovation utilized for directing organization bundles in an organization. The sending of bundles is done based on the marks present on the parcels following a fixed way named Label Switched Path (LSP) (Fathurrahmad and Yusuf, 2019). It has number of befits which are as follow:

- Speed
- Traffic Engineering (TE)
- Better IP over ATM Integration
- Overlapping Address Pools
- Optimal Traffic Flow
- Quality-of-Service (QoS) (Akinsipe et al., 2012).

IP Routing utilizes sending and forwarding packets dependent on the objective IP address, lookups of routing are performed on each bounce and each switch may require full Internet directing data. Subsequently, It is done based on the IP address utilizing the mechanism of hop-by-hop (SHabaev and Matygov, 2020).

Proposed Network Design and Implementation

This section presents the logical network design of VIVID Medical Center. As mentioned earlier, there is 7 floors at that medical center. However, in logical design both ground and first floor will be illustrate due to remain floor are include only three or less of network device and computers. Give below is the logical design including first floor, ground floor and server side.
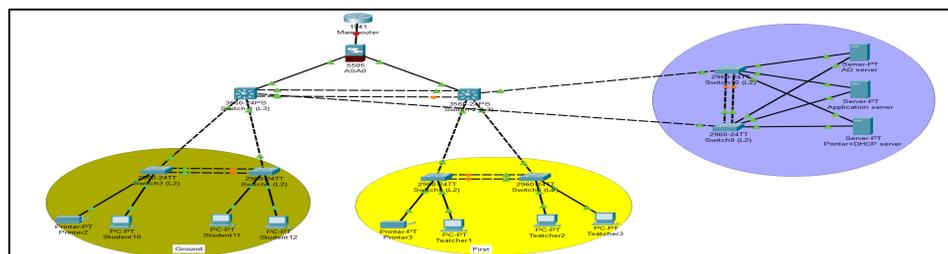
Figure 3. Logical network Design
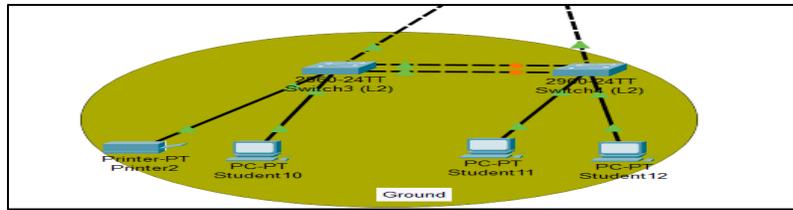
Figure 4. Ground Floor:

In ground floor, there are two layer two switches. Both switches are have 48 ports due to there are 45 users in this floor and 10 printers as well. The end user device are connected in equal approach to layer tow switches to provide balance in bandwidth. The two-layer switches connected over redundant link to provide redundancy and fault tolerance.
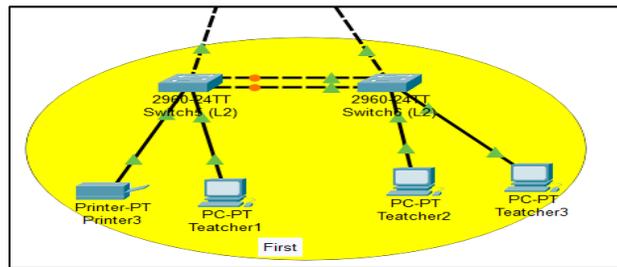
Figure 5. First floor:

In first floor, there are two layer two switches. Both switches are have 48 ports due to there are 45 users in this floor and 10 printers as well. The end user device are connected in equal approach to layer tow switches to provide balance in bandwidth. The two-layer switches connected over redundant link to provide redundancy and fault tolerance.
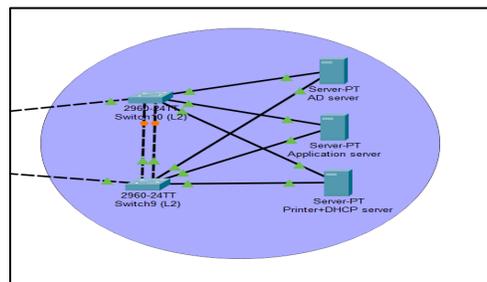
Figure 6. Servers Setup

In server design, it has three main servers are AD (Active directory, Application and Printer and DHCP (Dynamic Host Configuration protocol and) servers. All server are connected to two layer switches to provide load balance and fault tolerance. In addition, same to layer two switches that connected over redundant link to provide redundancy and fault tolerance.
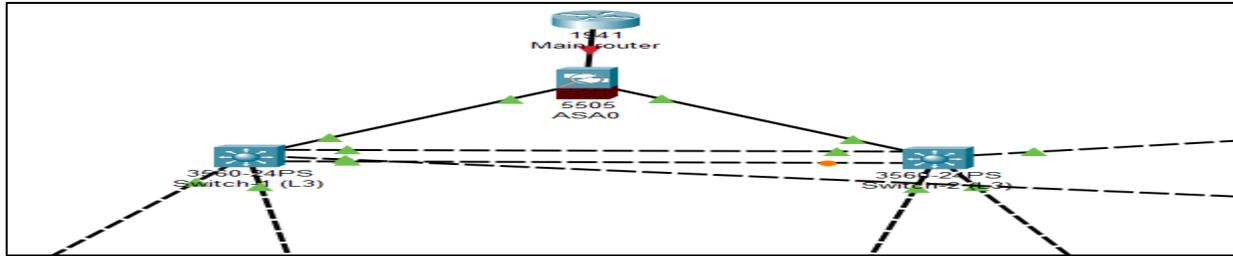
Figure 7. Distribution and core layer

In distribution layer design, it has two switches, which are consider layer three switches. The switches one is connected to end user devices that in ground floor and another layer three switches is connected to first floor devices. These switches connected to ASA firewall and then connected directly to router. The switches are connected to over cross cable but with firewall connected to straight cable. Following is the IP scheme used for connectivity.

Subnet Name	Needed Size	Allocated Size	Address	Mask	Decimal Mask	Assignable Range	Broadcast
First Floor	57	62	192.168.1.0	/26	255.255.255.192	192.168.1.1 - 192.168.1.62	192.168.1.63
Ground Floor	56	62	192.168.1.64	/26	255.255.255.192	192.168.1.65 - 192.168.1.126	192.168.1.127
Server	3	6	192.168.1.128	/29	255.255.255.248	192.168.1.129 - 192.168.1.134	192.168.1.135

Result and Discussion

This section presents the data collection and analysis approach used for this paper. Questionnaire and the interviews are used for the data collect information. Therefore, the interview will be analyzed by coding each question with a single keyword. Then collect all the answers and explain them based on the most closely related. The method of analysis will be descriptive and narrative. As for the questionnaire, it will be analyzed using the well-known Excel program. As all responses will be collected in a table. Then analyzed in the form of charts and explained based on the results of the charts. There were 30 employees from the medical center who replied about the questionnaire that done it online due to COVID-19 pandemic. Anyway, the result of the five close-ended questions is listed below with brief graph and explanation.
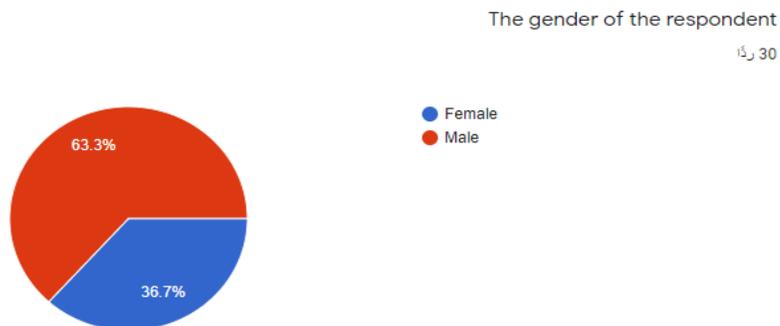
Figure 6. Analysis of the questioner

The graph show that 63.3% of responders were female where only 36.7% were male. This means that most of the female were interested to participate in the survey. How satisfied are you with the current network of the medical center?
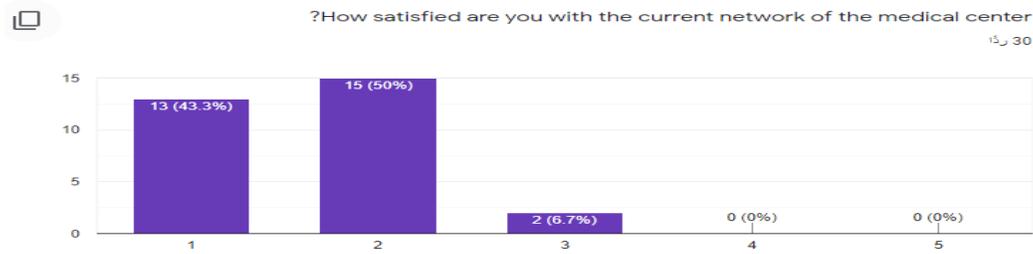
Figure 7. Analysis of the questioner

The graph show that 43.3% of responders not satisfied about the current network and 50% were addressed that they have good network where only 6.7% were showed that is in between. This means that most of the responders were not satisfied about the medical center network. Does the current network perform all the requirements in the field of work?
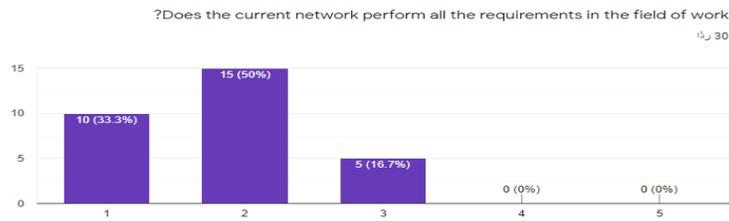
Figure 8. Analysis of the questioner

The graph show that 33.3% of responders not satisfied about the performance of current network and 50% were addressed that they have acceptable network where only 16.7% were showed that is in between. This means that most of the responders were not satisfied about performance of current network.
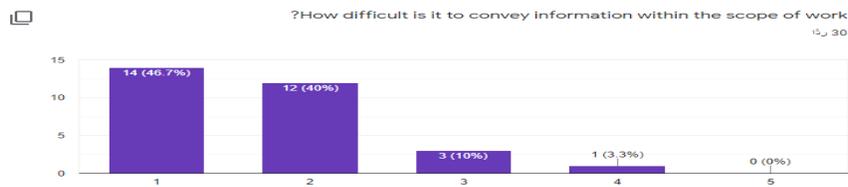
Figure 9. Analysis of the questioner

The graph show that 46.7% of responders faced difficulties to share information among current network and 40% were addressed that it is acceptable where only 10% were showed that is in between. This means

?Are you satisfied with the current safety system

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- Yes
- No
- Maybe

26.7%

73.3%
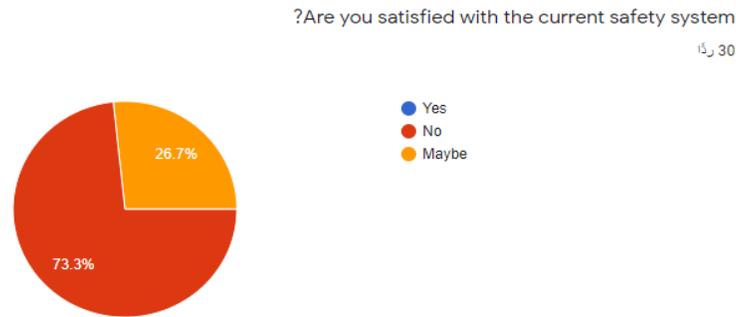
Figure 10. Analysis of the questioner

The graph show that 73.3% of responders not satisfied about the security of current network and 50% were addressed that they are not sure about it. This means that most of the responders were faced weak network security.

Conclusion

Proposed network solution is based on MPLS which enhances network connectivity and reduces network congestion along with data security, thus increase productivity of network operations and provides better end user user's experience. Also, data carrying real time packets such as voice can be assigned to low delay routes across the network so that time dependent traffic can be transferred before its time to live (TTL) expired, to ensure guaranteed quality of services for real time traffic. In addition, the deployment of MPLS is considered as a part of virtual private network and thus can be considered a secure transport mode, and is secure against denial of service attacks.

Acknowledgements

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