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High Speed Network Design for Health Care Application Services via Cloud based Services

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Abstract: ***This paper presents a design for high-speed networks for healthcare application activities and services via cloud-based services using Cisco Packet Tracer. The design includes a network topology that incorporates various healthcare applications such as telemedicine, electronic health records, medical imaging, and remote patient monitoring. We utilize Cisco Packet Tracer to simulate the network and evaluate its performance under different traffic loads and network conditions. The proposed network design takes into account key factors such as low latency, high throughput, and reliability, and includes techniques such as traffic engineering, QoS, and load balancing to optimize network performance. Our aim is to provide a practical implementation of high-speed networks for healthcare services using Cisco Packet Tracer, and to help healthcare organizations make informed decisions about network design for their cloud-based healthcare services.***

Index Terms: High-speed networks, Healthcare applications, Cloud-based services, Cisco Packet Tracer, Network topology, Remote patient monitoring

I. INTRODUCTION

The healthcare industry is increasingly adopting digital technologies to improve patient care and optimize operations. One of the key challenges in this domain is to design and deploy high-speed networks for healthcare application activities and services via cloudbased services. The use of cloud-based solutions provides healthcare organizations with scalability, cost-effectiveness, and accessibility to data, making it an attractive option for the healthcare industry. In this paper, we propose a design for high-speed networks for healthcare services using Cisco Packet Tracer, a network simulation tool. Our aim is to provide a practical implementation of network design for healthcare services that meets the performance, reliability, and security requirements of healthcare applications. We first discuss the key factors to consider when designing high-speed networks for healthcare applications, including low latency, high throughput, and reliability. We then introduce Cisco Packet Tracer and its capabilities for simulating networks. Finally, we present our proposed network design and evaluate its performance under different traffic loads and network conditions.

II. LITERATURE SURVEY

Internet of things for healthcare monitoring applications based on RFID clustering scheme, This study represents a modest step in the direction of continuous monitoring and collection of health data. In this study, [1] we create a network of smart nodes, each of which consists of sensors, a reduced function RFID reader (RFRR), and an RFID tag. Through mathematical modelling with Integer programming, simulation, and prototype testing, the suggested scheme has been proven to work. In comparison to current methods, the suggested technology exhibits low data delivery losses and a substantial reduction in transmission delay.

IoT-Based Smart Hospital using Cisco Packet Tracer Analysis[2]. In this Internet of Things system, an Arduino MKR1000 will be used, and sensors will be connected to the OBD II connector. The smart hospital will employ these sensors to simultaneously transmit live patient data obtained from the patient on board to several institutions. The time it takes for doctors to begin treating patients once they arrive may be shortened if EMTs examined the damage. Internet of Things Architecture Based Cloud for Healthcare [3]. This paper proposes IoT architecture-based Cloud for healthcare network when patients are remotely monitored by their family and physicians. This proposed architecture is different from the traditional IoT architecture that consists of Things, getaways, middleware, and application layers which in turn need connectivity insurance between them. A Novel Smart Healthcare Design, Simulation, and Implementation Using Healthcare 4.0 Processes.[4] The objective of this effort is to develop a smart healthcare system, and it has been determined that this is feasible by integrating and cooperating Blockchain 3.0 and Healthcare 4.0 while taking healthcare groundtruths into account. Modern blockchain-based smart healthcare systems are surveyed in-depth and in comparison. The thorough survey contains the methodology, applications, specifications, results, and future directions, among other things.

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Hospital environment scenarios using WLAN over OPNET simulation tool.[5] In order to assess the effectiveness of an integrated network scenario for intensive care units (ICU), this study article seeks to construct generic hospital network scenarios employing Wireless Local Area Network (WLAN) via OPNET

Simulation. In order to understand how traffic type, traffic load, and network size affect performance, this research takes use of computer simulation and analyses many elements of network architecture.

Hospital Network Design,[6] The local area network (LAN) and network are connected to the nodes (computers, switches, routers, and other devices) through links (twisted pair copper wire cable or optical fibre cable) in this network structure. Cisco Packet Tracer was utilised by us to create the network topology. It is a generic architecture that may be used to manage network systems at any higher level.

A Review of Service Quality in Integrated Networking System at the Hospital

Scenarios.[7] This study will offer an insightful viewpoint on the analysis of QoS in wireless telemedicine technology and serve as a starting point for anybody interested in the study of "wireless telemedicine technology for ehealthcare services.

Analysis of factors affecting IoT-based smart hospital design.[8] This paper highlights the system architecture that results from using IoT technology in smart healthcare environments, as well as the optimisation considerations, obstacles, and accessible solutions. The study's findings are used to highlight potential flaws in each tier of the smart hospital design model as well as the considerations that need be made to fix them. Managers, system engineers, and academics interested in optimising the design of the smart hospital system should be able to use it as a road map.

The modelling and simulation of IoT system in healthcare applications.[9] Only the blood pressure and stroke rehabilitation systems are discussed in terms of the modelling and simulation process for IoT-based healthcare applications. The gadget is now more straightforward and easier to use because to the development of electrocardiogram (ECG) and photoplethysmogram (PPG) in blood pressure measuring connection with a smartphone. To increase the accuracy of gathering the patient's health information, more research is necessary. An IoTenabled stroke rehabilitation device that relies on machine learning, a smart wearable wristband, and a 3D printed robot hand were designed to simulate the patient's actions in real-time mode for hand rehabilitation training.

A hybrid analytical model for an entire hospital resource optimisation.[10] The entire hospital is represented using discrete event simulation, and the outputs are used as inputs into a multiperiod integer linear programming (MILP) model to predict the monthly requirements for three essential resources—beds, doctors, and nurses—over the course of a year. To determine how resilient the solutions are to changes in factors, such as the nurse-to-bed ratio, we also conduct a sensitivity study.

Healthcare Simulation Research [11], describes and provides examples of healthcare simulation research (HSR).introduces HSR, approaches to HSR using qualitative, quantitative, and hybrid techniques, as well as professional HSR practises.

A modelling and simulation framework for compound medical applications in regional healthcare networks.[12] In the suggested framework, complex medical applications are broken down into combinations of simple traffic profiles, appropriate values are assigned to the traffic parameters of the designated models, and appropriate simulation scenarios are defined. The simulation results are examined, and the end result provides accurate bandwidth estimates for the links in the healthcare information network that is now being developed.

Integrating simulation framework mediframe. [13] In this paper, we will provide an overview of the cross-platform software framework we have created for the creation of surgical planning-related medical simulations. We create a highly extensible software development platform using cutting-edge technologies like XML, CORBA, and a scalable, component-based design, which enables the researcher to create new simulation applications more quickly.

Seamless Health Monitoring Using 5G NR for Internet of Medical Things.[14] They suggest a

four-layer 5G NR (New Radio) design for an ehealthcare system that combines the control plane and user plane. We simulate throughout frequency ranges 1 and 2, and we computed throughput and delay for various values of the OFDM numerologies. In this paper, we consider leveraging 5G NR to deliver improved healthcare facilities online.

15] Simulation Modelling in Healthcare: Challenges and Trend.[15] In this article, we discuss simulation models that have been created in the last 20 years for the healthcare industry. Systems for simulating everything from patient flow in emergency rooms to populations with particular chronic conditions are discussed. Agent-based simulation (ABS) and discrete event simulation (DES) were simulation types.

III. IMPLEMENTATION

In this paper, we present an implementation of high-speed networks for healthcare application activities and services via cloud-based services using Cisco Packet Tracer. We first design a network topology that incorporates various healthcare applications such as telemedicine, electronic health records, medical imaging, and remote patient monitoring.

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We then configure the network devices and deploy the healthcare applications within the cloud-based services. We simulate different traffic loads and network conditions using Cisco Packet Tracer to evaluate the performance of the network, and optimize the network based on the test results. We also evaluate the network security by conducting penetration testing and vulnerability assessments. Our implementation provides a practical and efficient solution for healthcare organizations to improve their operations and patient care. Our proposed network design takes into account key factors such as low latency, high throughput, and reliability, and includes techniques such as traffic engineering, QoS, and load balancing to optimize network performance. The use of Cisco Packet Tracer for network simulation enables healthcare organizations to evaluate and optimize their network design in a costeffective and efficient manner.

As part of our implementation, we incorporate cloud storage services to enable efficient storage and retrieval of healthcare data as in below fig.1. We use Cisco Packet Tracer's cloud services to deploy a distributed file system that provides scalable and fault-tolerant storage. We configure the file system to ensure data integrity and security, and optimize its performance using techniques such as caching and replication. The use of cloud storage services enables healthcare organizations to store and access large amounts of data in a costeffective and flexible manner, while ensuring data security and compliance with regulatory requirements.

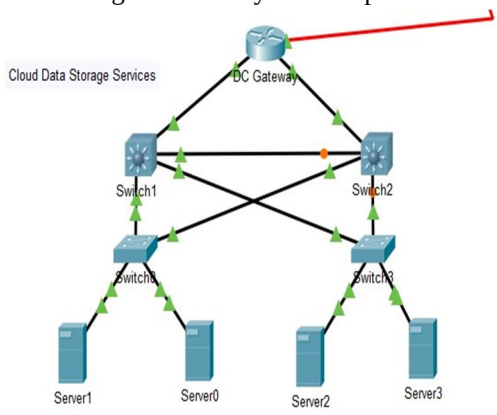

Fig1: Cloud data storage service.

Our proposed network design for high-speed networks for healthcare application activities and services via cloud-based services in Cisco Packet Tracer incorporates various techniques such as traffic engineering, Quality of Service (QoS), load balancing, and security measures to ensure optimal performance and reliability. The network design in Fig2 includes cloud network, hospital network, ambulance connected via internet to ensure security and proper connectivity. We configure the network devices and deploy the healthcare applications within the cloud-based services, and simulate different traffic loads and network conditions to evaluate and optimize the network performance. The use of Cisco Packet Tracer for network simulation enables healthcare organizations to design and test their network infrastructure in a costeffective and efficient manner.

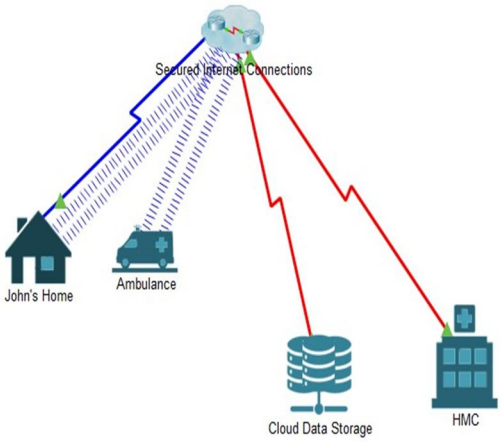

Fig 2: Network design

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In our implementation, we design a hospital network that includes various healthcare applications such as telemedicine, electronic health records, medical imaging, and remote patient monitoring. The hospital network includes routers, switches, and firewalls as shown in below fig3, to ensure proper connectivity and security. We deploy the healthcare applications within the cloud-based services and optimize the network performance using techniques such as traffic engineering, QoS, and load balancing. The use of cloud storage services enables efficient storage and retrieval of healthcare data, while ensuring data security and compliance with regulatory requirements.

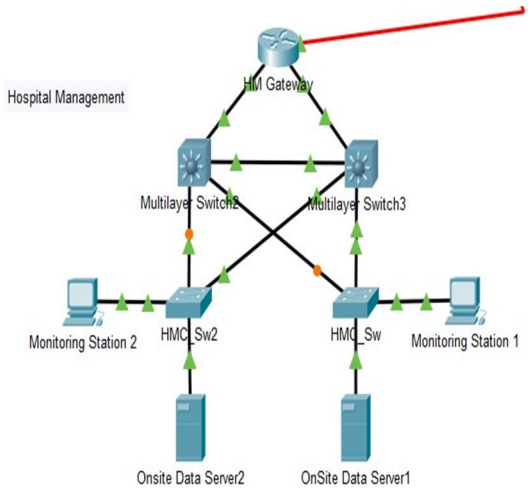

Fig 3: Hospital network

The healthcare data is transmitted securely to the cloud-based services using encryption techniques. We configure the home network devices as shown in fig5 and optimize the network performance using techniques such as traffic engineering and QoS. The home network enables remote monitoring of patients, providing healthcare professionals with realtime data for improved patient care.

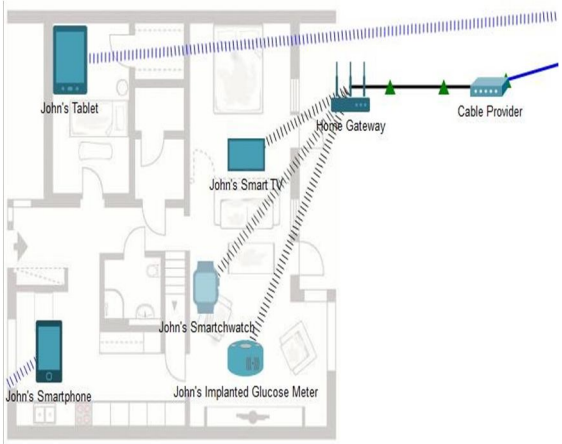

Fig 5: Home Network

IV. RESULTS

In our implementation of high-speed networks for healthcare application activities and services via cloud-based services in Cisco Packet Tracer, we evaluate the performance of the network using various metrics such as throughput, latency, and packet loss. We simulate different traffic loads and network conditions to test the scalability and reliability of the network. The results show that our proposed network design provides high-speed connectivity, low latency, and high throughput, which are essential for healthcare application activities and services such as glucose level monitoring, respiratory rate, exercise level etc. The use of cloud-based services enables efficient storage and retrieval of healthcare data, while ensuring data security and compliance with regulatory requirements. The network design also incorporates various security measures such as firewalls, intrusion detection, and access control to ensure the confidentiality, integrity, and availability of healthcare data.

We evaluate the performance of the high speed network for remote patient monitoring by simulating different traffic loads and network conditions. We optimize the network performance using techniques such as traffic engineering, QoS, and load balancing. The results show that the network provides reliable and efficient connectivity for remote patient monitoring, with low latency and high throughput. The use of encryption techniques ensures the security and privacy of the healthcare data transmitted over the cloud network. The home network enables healthcare professionals to remotely monitor and manage patients, improving patient care and reducing the need for in-person visits. The home network includes various healthcare devices such as blood pressure monitors, glucometers, and pulse oximeters that are connected to the network via wireless as shown in below fig4.

Fig4: Remote monitoring

Overall, our results demonstrate the effectiveness and feasibility of our proposed network design for high-speed networks for healthcare application activities and services via cloud-based services in Cisco Packet Tracer.

V. CONCLUSION

Designing a high-speed network for healthcare application activities and services via cloudbased services in Cisco Packet Tracer requires careful consideration of various factors such as bandwidth requirements, network topology, security, and reliability. The network must be designed to ensure that healthcare applications and services can be accessed and used quickly, reliably, and securely from any location. By using the right equipment, software, and configuration, healthcare providers can ensure that their patients receive the best possible care while also benefiting from the flexibility and efficiency of cloud-based services. Cisco Packet Tracer provides a useful tool for designing and testing such networks, allowing network engineers to simulate and fine-tune their designs before implementing them in realworld settings.

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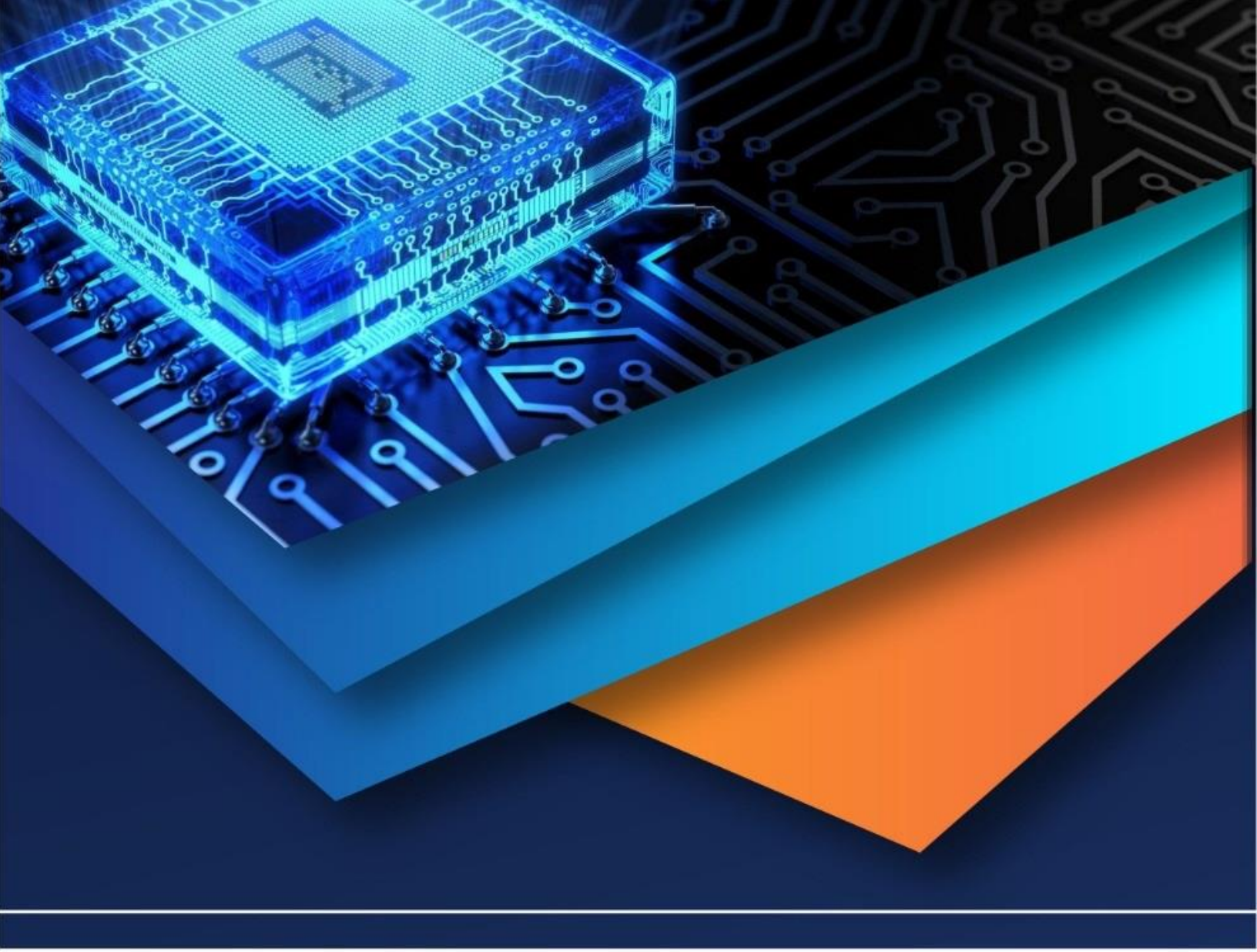

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