Improving Quality of Service in 5g Networks Through SDN and MATLAB Simulation

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Abstract Confidence in the quality of modern communications networks plays an important role as a driver of the technological and market success of any communications technology or service. most technological approaches to this problem focus only on network security and do not include an aspect such as quality of service (QoS), which also plays an important role in the formation of trust, both on the part of consumers and on the part of the regulator. Whereas trust in 5G networks lies in the areas of formation of quality-of-service requirements managing and defining it requirements. One of the techniques use to improve the quality of service in 5G networks was applied in this work, namely (SDN), and MATLAB was chosen as a simulation environment for this technology to ensure a large volume of data with little delay and large bandwidth with high productivity, with was observed in the results.

Keywords - Quality of Service, 5g Networks, SDN, MATLAB.

I.INTRODUCTION

The fifth generation of mobile networks (5G) is set to transform the telecommunications industry by allowing for faster data transfer rates, lower latency, and greater connectivity. However, deploying 5G networks presents significant challenges for network operators, who must ensure that the quality of service (QoS) provided to users is high and consistent across the network.

One approach to addressing these issues is to use software-defined networking (SDN) and network function virtualization (NFV) technologies, which enable network operators to manage and optimize network resources dynamically based on real-time traffic demands. SDN enables centralized network control, allowing for more efficient resource allocation and better QoS management, whereas NFV enables network function virtualization, allowing for more flexible and scalable network architectures.

In this context, MATLAB simulation is a powerful tool for evaluating 5G network performance and assessing the impact of SDN and NFV technologies on QoS. MATLAB provides a variety of simulation tools and techniques for modeling and simulating complex network scenarios, allowing network operators to test and refine network designs before deploying them in the real world.Network operators can significantly improve the quality of service provided to 5G network users by combining SDN and MATLAB simulation. This can lead to increased user satisfaction, increased network efficiency, and increased network profitability, making SDN and MATLAB simulation essential tools for 5G network deployment and optimization. Network operators generally accommodate high quality of service applications by providing more network resources to ensure the required service and performance taking in to account peak requirements. this process it becomes complex and more difficult with the development of a large number of new applications and service with strict performance requirements. to meet such a challenge efficiently the fifth generation was introduced.It has promised to provide reliable services at ultra-high speedwith very low latency.5G will deliver both fixed as well as mobilebroadband services anywhere to anyone at any time.In order to enhance the potential of 5G, Software Defined Network (SDN) is introduced to achieve flexibility in the resource allocation process, allows an operator with an SDN-enabled transmission network to allocate network resources efficiently develop users' demands and adjust resource allocation and network optimization use while ensuring the provision of high quality of service and bandwidth instability.

The objectives of this Research are

- To decrease delay.

One of the primary goals of 5G networks is to reduce network latency. In the context of network communication, delay refers to the amount of time it takes data packets to travel from their origin to their destination. Low latency is critical in the context of 5G networks for applications such as real-time video streaming, online gaming, and

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autonomous vehicles. Decreased delay will aid in ensuring that data transmission and communication occur in near real-time, resulting in a more fluid and responsive user experience.

- To increase throughput.

The amount of data that can be transmitted over a network in a given amount of time is referred to as throughput. To handle the increasing data demands of modern applications such as high-definition video streaming, augmented reality, and IoT devices, 5G networks must increase throughput. The thesis seeks to improve throughput in order to make the network more capable of handling a higher volume of data traffic efficiently.

- To increase bandwidth.

A network's bandwidth is its ability to transmit data. Increased bandwidth in the context of 5G means expanding the network's capacity to accommodate more devices and higher data rates. This is critical in order to support the growing number of connected devices and applications that require large amounts of bandwidth. The thesis aims to ensure that the 5G network can meet the demands of future technologies by increasing bandwidth.

MATLAB Simulation and SDN (Software-Defined Networking): The use of Software-Defined Networking (SDN) and MATLAB simulation tools suggests that the thesis intends to use technology and simulation techniques to achieve the aforementioned goals. SDN enables dynamic network management and control, allowing network resources to be optimized for lower latency, higher throughput, and increased bandwidth. MATLAB simulation allows for the modeling and testing of these improvements in a controlled environment, allowing for experimentation and analysis prior to implementing changes in a real 5G network.

II.LITERATURE REVIEW

The fifth generation of wireless communication technology, known colloquially as 5G, has ushered in a new era of connectivity and communication. 5G networks are a paradigm shift from their predecessors (2G, 3G, and 4G) in that they promise not only faster data speeds but also unprecedented levels of reliability, low latency, and connectivity for a wide range of devices. The widespread deployment of 5G is expected to transform industries such as healthcare, transportation, manufacturing, and entertainment by enabling a wide range of applications such as autonomous vehicles, IoT, augmented reality, and remote surgeries.

The Quality of Service (QoS) Imperative:

As 5G networks become the backbone of modern digital society, the need for stringent Quality of Service (QoS) requirements grows. In contrast to previous generations of networks, 5G must deliver consistent and dependable performance for a wide range of applications, each with its own set of QoS requirements. High bandwidth is required for high-definition video streaming and massive IoT deployments, while ultra-low latency is required for applications such as autonomous vehicles and real-time remote surgeries. It is a formidable challenge to achieve and maintain the required QoS in this dynamic and heterogeneous environment

The Function of Software-Defined Networking (SDN):

The networking industry has turned to Software-Defined Networking (SDN) as a transformative approach to address the complex task of managing QoS in 5G networks. By decoupling the control plane from the data plane, SDN fundamentally reimagines network architecture, allowing for centralized and dynamic control over network resources. This architectural shift allows network operators to adapt and optimize network behavior in real-time, in response to the varying demands of various applications and services.

SDN as a QoS Enhancement Solution:

The ability of SDN to provide centralized control, programmability, and dynamic resource allocation is ideal for 5G networks. It enables network operators to define and enforce QoS policies, prioritize traffic, and efficiently allocate resources. Furthermore, SDN enables network slicing, a key feature of 5G, by allowing the creation of isolated virtual networks with customized QoS parameters for specific use cases.

III.RESULTS

Table below show simulation parameter used in the different scenarios of the simulation

Table 3.1 : simulation parameter:

Parameter	Value
Number of all virtual node	8
Control node	3
Bandwidth	4MHZ
Number of bits	100Bit
Actual data rate	2
Code rate	0.5

The MATLAB code provided simulates the creation of a virtual network topology with a given number of nodes, random node placements, and random communication links between nodes. It is a simple starting point for simulating network topologies and can be used to prepare for more complex simulations.

The provided extended MATLAB code simulates and visualizes a 5G network topology with SDN controllers. Discussions on the simulation results and potential considerations for improving the quality of service in 5G

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networks using SDN and MATLAB simulation can be found here. Visualizing Network Topology: The code provides an easy-to-understand visual representation of the 5G network topology with SDN controllers, which is critical for understanding the physical layout of network nodes and controllers.

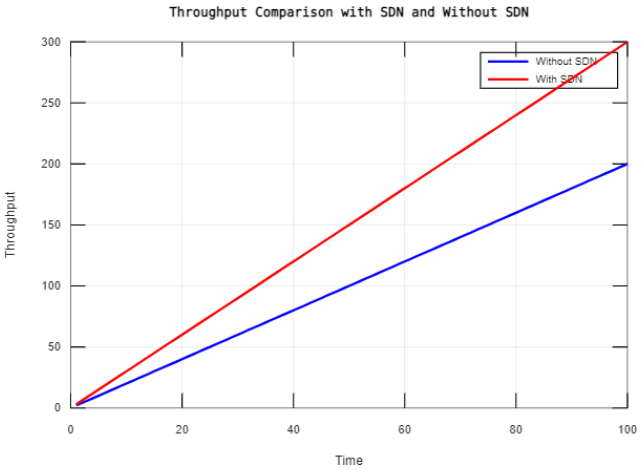

Figure 3.2 represents the change in throughput with time , and we note that throughput increases linearly with time .

In the virtual network at point 5 is equal to 0.5*10^6 and when using SDN equal 1.3*10^6 .

Increment =(1.3-0.5)*10^6

=0.8*10^6. Percentage increase = 0.8*10^6/0.5*10^6 = 160%

represents the change in bandwidth, in the virtualnetwork bandwidth = 4, and when using SDN = 4.75 .

The increase = 4.75 – 4 =.75.

Percentage increase = .75/4*100% = 18.75% .

The MATLAB code provided simulates and compares the change in bandwidth over time for a network without SDN and a network with SDN. Here are some thoughts on the simulation results and considerations for improving service quality in 5G networks using SDN and MATLAB simulation:

Parameters for simulation:simulationTime: This parameter specifies the simulation's total duration. Time Step: It specifies the simulation's time step, which controls the granularity of the simulated time. Bandwidth Simulation: The code simulates the evolution of bandwidth in networks with and without SDN.

The bandwidth in the network without SDN remains constant at 4 units throughout the simulation. The bandwidth of an SDN network increases linearly over time with a coefficient of 0.75 units per time step. The code plots the results, allowing you to see how the bandwidth evolves over time for both scenarios.

IV. CONCLUSION

The fifth-generation network is a network with high features in which the network parameters have been improved and thus improve the quality of service.

The short path algorithm has many advantages such as reducing the data path and throughput and delay.

In this research, specific specification was introduced MATLAB to design a topology for a traditional network with number of nodes and a topology for another network choosing a part of the nodes for the control (SDN).

The results were compared in the traditional network with the network when applying SDN , and the increase in throughput and bandwidth was observed in a linear, and the delay was also decrease in a linear manner.

The increase percentage was calculated for each of the throughput and bandwidth and found 160% and 18.75% ,respectively ,and the decrease in the delay was calculate and found 72% from the above , we note that the use of SDN led to an improvement in the service quality parameters mentioned above , and consequently to the increase in quality of service.

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