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A Novel Performance Probability Model for Capacity Assessment of Communication Channels in 5G Wireless Mobile Networks

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ABSTRACT- Capacity assessment of communication channels in 5G wireless mobile networks is essential for optimizing wireless networks for data-intensive applications. Capacity assessment can help determine optimal channel conditions by considering the effects of various physical characteristics such as noise, interference, spectrum limitation, and subscriber density. Additionally, capacity assessment can help identify and characterize the critical technical challenges likely to limit the performance of a wireless network and identify areas for improvement. The novel Performance Probability Model (PPM) for capacity assessment of communication channels in 5G wireless mobile networks is a powerful tool for accurately predicting the future performance of 5G networks. It considers various performance factors such as interference levels, data rates, transmission range, and available spectrum. The model uses statistical methods and probability analysis to generate performance predictions of a 5G system. Using existing knowledge concerning radio communication channel properties, it can estimate the performance probability that a given 5G system can deliver within given environmental constraints. The proposed PPM achieved 87.95% data range, 94.33% scalability, 90.99% latency, 91.60% signal strength, 90.21% bandwidth assessment, and 90.76% reliability. The PPM is a crucial enabler for accurately evaluating the 5G network performance and helps enable informed decisions about system deployment. Moreover, the model is amenable to experimentation and calibration to make it more accurate, reliable, and applicable to other 5G network deployments.

Keywords: Capacity, Communication, Channels, Wireless, Mobile, Networks, PPM.

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1. INTRODUCTION

Wireless mobile networks and communication channels have become increasingly important in today's connected world. Fifth-generation technology (5G) is the latest of many developments in this field, offering faster and more reliable communication than ever before. However, its success relies heavily on the ability of network providers to accurately assess the capacity of communication channels to ensure they can meet user demand [1]. First and foremost, capacity assessment is vital in the design of more efficient network infrastructure. By understanding the existing capacity, network operators can identify which areas of the network require additional resources, allowing them to prioritize their investment accordingly. It enables them to provide a faster and more reliable service, improving customer satisfaction. Additionally, capacity assessment can also be used for troubleshooting and identifying potential areas of congestion before they occur. It can help to reduce latency issues, meaning that users can enjoy a better overall experience [2]. In 5G networks, capacity assessment is critical since the technology has the potential to revolutionize everyday life. With millions of devices connected to the same network, providers must be able to ensure their systems can handle the increased strain without impacting the user experience. As such, capacity assessment needs to consider each network component, from the router and access points to the channels used for transmission. By using detailed capacity assessment, network providers can ensure they can correctly and efficiently accommodate the massive network traffic that comes with 5G technology [3]. It will be vital to realize all of the potential of this innovative technology, allowing society to take full advantage of its fantastic speed, reliability, and bandwidth [4]. 5G is revolutionizing how people use technology. Through its revolutionary advancements, 5G puts more aspects of modern life within reach and allows faster data transmission. 5G promises faster speeds and better coverage, allowing for higher levels of connection, more reliable service, and faster file transfers. To ensure that these 5G capabilities can be used effectively and efficiently, capacity assessment of communication channels has become an indispensable part of the process [5].

The capacity assessment involves analyzing the characteristics of the channel, such as frequency, bandwidth, and data privacy features, and quantifying their impact on data throughput. Through rigorous assessment, wireless networks can be optimized to maximize data throughput while ensuring the quality of service (QoS) requirements are met. Capacity assessment of communication channels assesses how much information can be transmitted over different communication channels on a given network [6]. It includes measuring the large packet sizes, analyzing how many users can be supported simultaneously, and ensuring the signal strength is strong enough to carry data quickly. These must be considered to ensure the 5G wireless mobile network meets performance expectations [7]. Examining the capacity of the various communication channels will make it possible to identify which are best suited for different applications and any potential bottlenecks. This knowledge can then determine which solutions will work best for a particular application and which are too inefficient to use [8-9]. Such assessments can also provide insight into when upgrades might be needed to provide the desired service level. In addition to assessing capacity, capacity assessment of communication channels can also be used to determine the need for new solutions and technologies [10]. For instance, emerging 5G technologies such as massive MIMO, small cell deployment, and beam forming require careful assessments of their respective channel capacities to ensure their potential performance can be adequately exploited [11]. The bottom line is that capacity assessment of communication channels is vital to developing 5G wireless mobile networks and allowing for the necessary data transmission speeds and reliable connections. By taking the time to assess the capabilities of different communication channels, better performance and more efficient networks can be achieved [12].

5G wireless mobile networks are the most advanced communication networks, offering unmatched flexibility and an excellent capacity for managing and storing data. However, their capacity for communication channels must be carefully assessed to ensure reliable and secure transmissions [13]. 5G wireless mobile networks connect data over vast distances using multiple communication channels. Depending on the type of application, the capacity of each of these communications channels needs to be assessed to properly manage traffic flow and prevent a congested network [14]. In order to accurately assess the capacity of communication channels, various measurements can be taken, including measuring propagating distance, peak throughput, data slots, interference sources, and overall coverage. Additionally, the impact of environmental factors, such as weather, must be considered to prevent sudden drops in network speed and reliability [15]. Furthermore, communication channels should be tested for compatibility with emerging technologies, such as Massive MIMO arrays, Radio Channel Arrays, and millimeter wave technology. It would ensure the seamless integration of these technologies into the overall 5G wireless mobile network [16-17]. Additionally, the communication channels' capacity must be considered regarding mobility. It means that when a device moves across different channels, its performance must not be interrupted as it transitions from one channel to the following [18]. Finally, to assess the capacity of communication channels in 5G wireless mobile networks, the reliability of the channel needs to be tested. It can be done by measuring the latency of the channel and the rate of dropped packets, as well as determining how much data a channel can store [19]. Overall, the capacity assessment of communication channels in 5G wireless mobile networks requires careful consideration and assessment. Testing each channel and combining the results with environmental and user factors will ensure that the best possible service is provided to the users [20]. The following are the key contributions of this research work. They are,

- **Enhanced throughput and reduced latency:** The capacity assessment of communication channels in 5G wireless mobile networks can help to identify potential configuration options that can improve the throughput and reduce the latency of the network.
- **Improved end-to-end performance:** By assessing the capacity of communication channels, the performance of 5G wireless mobile networks can be significantly improved.
- **Detection of coverage issues:** A capacity assessment can be used to detect any coverage issues in the network and identify areas that require improvement.
- **Determining the network's reliability:** Capacity assessment is essential in determining the network's reliability by evaluating the current connection status and performance.
- **Increased spectral efficiency:** Capacity assessment helps identify the channels available for communication, allowing for increased spectral efficiency by using the available resources.

The remaining portion of this paper is structured as follows. The literature on the subject of the investigation is displayed in *section 2*. The planned research approach is described in *section 3*. The analytical discussion is presented in *section 4*. Finally, *section 6* displays the conclusion and future scope. *Section 5* offered a comparative analysis of findings between the current and new models.

2. MATERIALS AND METHODS

Zhang, K., et al. [21] have discussed the measurement and modeling of path loss and channel capacity analysis for the 5G UMa (Urban Mobile Access) scenario, which involves evaluating path loss from the base station to the user in different transmitter and receiver configurations. The path loss is measured to understand the performance of the spectrum for 5G technology and to determine the capability of a specific type of access network. Channel capacity analysis assesses the amount of data transmitted over the wireless medium and helps design the spectrum to provide maximum data rate. This analysis determines data rate and packet size supported by different access networks. Logeshwaran, J., et al. [22] has discussed a new system design methodology that incorporates AI/ML to perform real-time processing of resource requests from various applications and quality of service requirements from users, making decisions in milliseconds to help maximize the efficiency of the network. It considers various factors, such as traffic demands, user profiles, QoS requirements, etc., to determine the best allocation of resources for various applications. It enables the network to allocate resources dynamically according to the needs of the applications and users to ensure quick response times and minimize latency. Moreover, the intelligent decision model also helps with proactive resource provisioning and optimization of 5G broadband communication networks. Qiao, J., et al. [23] has discussed enabling D2D communications in millimetre-wave

5G cellular networks. It means sending and receiving data directly between two networked devices, such as smartphones, tablets, or laptops, without transmitting it through the cellular network. It could increase data speeds, reduce latency, and even allow users to exchange data without a cellular provider. Millimetre-wave 5G cellular networks are expected to provide wider bandwidth and lower latency than current cellular systems, allowing for more efficient D2D communications.

Li, Q. C., et al. [24] has discussed that the 5G network capacity refers to the capabilities of a 5G wireless network in terms of bandwidth and data transmission speed. It is designed to increase data throughput over existing 4G networks, allowing more data to be transmitted and collected at higher speeds. Key elements and technologies for 5G network capacity include advanced antennas, millimetre wave spectrum, beamforming, massive MIMO, small cells, full-duplex networks, network virtualization, and cellular edge computing. This advanced technology can support higher data rates, increased capacity and scalability, reduced latency, and flexible network topologies critical for supporting future applications such as massive IoT and machine learning. Elayan, H., et al. [25] has discussed the opportunities of wireless technology beyond 5G, referring to the possibilities of utilizing and developing more advanced wireless technologies beyond the current 5G technology, such as 6G and beyond. It could include high-speed connectivity and services, better bandwidth efficiency, increased flexibility, a more extensive scope of applications, and enhanced communication capabilities. Additionally, this could result in greater availability of new and innovative services and resources and a better quality of experience for users. Islam, S. R., et al. [26] has discussed the power-domain NOMA, a multiplexing scheme used in 5G systems to use the limited spectrums efficiently. NOMA works by assigning multiple users to one unique resource block and then differentiating between the users according to their power levels. This approach allows more users to be served in any single resource block; then, their transmissions can be separated using the power levels. In order to do this, the receiver must be able to recognize the different power levels and decode the signals accordingly.

Wang, Y., et al. [27] has discussed a designed and set up to conduct experimental research into the mobile 5G technology. This platform will collect real-time data by experimenting with market segments and network infrastructures. It will allow developers to gain insights into how mobile 5G technology works and iterate their solutions to improve performance and usability. This data-driven approach allows developers to understand better how mobile 5G technology affects different user scenarios, allowing them to optimize their solutions accordingly. Giordani, M., et al. [28] has discussed the granted access to a base station or an access point to establish a connection. It is the first step in the 5G air-interface procedure. The UE device sends discovery signals and negotiates various parameters with the BS before establishing a connection. Initial access also includes validation of user authentication and access rights, allocation of radio resources, exchange of network capability information, and much more. Xiao, M., et al. [29] has discussed millimetre-wave communications as an emerging technology for future mobile networks. It uses high-frequency radio waves in the millimetre range to deliver high-speed, low-latency internet connections over short distances. Millimetre Wave networks promise to deliver significantly more capacity, speed, and lower latency than existing cellular networks. This technology is expected to play an important role in 5G mobile networks and beyond, enabling new applications and services that demand high bandwidth and low latency.

Yaqoob, M., et al. [30] has discussed an analytical study for the interaction of 5G femtocells and macro-cells, which refers to studying how two types of cellular networks can interact to form a unified, heterogeneous wireless cellular network. This type of modeling can then be used to assess the performance implications of integrating the two different types of networks and determine the best design for a unified cellular network. It could help determine how best to position and structure the two types of networks concerning one another to maximize network performance and coverage. Wang, D., et al. [31] has discussed the next generation of IoT-based intelligent algorithms and 5G technologies, the application of newly developed algorithms, machine learning, and predictive analysis models, and a new generation of IoT services and devices. These next-generation solutions will significantly improve the performance of IoT solutions, offer greater scalability and Security, and create vast opportunities for using IoT solutions in the industrial and consumer markets. Giordani, M., et al. [32] has discussed the multi-connectivity in 5G mmWave cellular networks, which refers to enabling a single user device to simultaneously connect to multiple base stations, both macro and small cell, to benefit from different characteristics. It signifies how 5G networks will provide higher throughput, improved coverage, and better range. This technology enables the use of multiple 5G networks for improved performance. Frecassetti, M. G., et al. [33] has discussed that the D-Band transport solutions use high-frequency radio waves in the 20-30 GHz band (known as the "D-band") for transmitting data between 5G cellular networks and beyond. It significantly increases the data rates in the networks, enabling reliable, low-latency, ultra-fast downloads across multiple devices. The D-band can also be used for massive machine-to-machine communication, thus improving network efficiency, and supporting the growth of the Internet of Things (IoT).

Gapeyenko, M., et al. [34] has discussed the Effects of blockage in deploying mmWave drone base stations for 5G networks and beyond, referring to the challenges of deploying high-frequency mmWave drone base stations. These frequencies are more susceptible to environmental blockages, such as buildings and foliage, making them less reliable in tackling high-density areas or challenging urban landscapes. It can lead to coverage gaps and a less reliable connection throughout the network. The mmWave drone base stations need to be deployed in various configurations to overcome the issue of blockages, allowing for more efficient network coverage. Ford, R., et al. [35] has discussed a framework for end-to-end evaluation of 5G mmWave cellular networks in ns-3, a software suite designed to measure the performance of 5G mmWave networks in a virtual environment. It provides an objective, numerical assessment of networks that cover network performance metrics such as end-user capacity, coverage, latency, and reliability. The software also offers a range of datasets for realistic mmWave channel modeling, providing an essential platform for developing and prototyping new 5G technologies. The ns-3 framework for 5G mmWave networks offers flexibility in simulation setup and allows for easy implementation of different types of networks and protocols. Khan, S. K., et al. [36] has discussed the performance evaluation of UAV relay communication networks as an assessment of the communications performance of these networks when used for UAV communications. It includes examining the throughput, latency, spectrum occupancy, Security, reliability, and other aspects of wireless communication to measure the viability and effectiveness of 5G UAV relay communication networks. This evaluation provides insight into developing improved network design strategies for enhanced performance and overall user experience for UAV applications.

Ratasuk, R., et al. [37] has discussed that M2M communications involve devices connected to mobile networks to exchange data and control devices remotely. Recent advancements in 4G networks have allowed M2M communications to become more widespread, allowing companies to deploy M2M-enabled applications in areas that were not previously possible. The development of faster, more reliable 5G networks will open up even more possibilities for M2M applications, as 5G networks are designed to accommodate the high data requirements of connected devices. 5G networks also offer improved latency and capacity compared to 4G networks, which could allow for new types of applications, such as autonomous vehicle networks, that are impossible on 4G networks. Busari, S. A., et al. [38] has discussed a process of measuring and analyzing the performance of the 5G mm-wide communication system. This evaluation ensures that the proposed 5G mmWave wireless communication system meets performance requirements. The evaluation can include such performance parameters as throughput, latency, and reliability. Additionally, the evaluation may cover aspects such as area coverage, radio resource management, handover, and interference. Zikria, Y. B., et al. [39] has discussed the potential of 5G, which could offer new solutions to existing challenges within healthcare, education, transportation, and more. 5G services offer great potential to support immersive and virtual reality applications, enhanced network analytics use, and improved device communication. Fang, D., et al. [40] has discussed the Security for 5G mobile wireless networks, which refers to data protection and technology used in 5G networks. It includes measures such as authentication, encryption, and access control. It also involves threat management, which involves detecting and responding to malicious attacks on 5G networks, secure software development, and secure deployment of 5G infrastructure. It is essential for the Security of 5G networks to ensure data privacy and Security and protect the confidentiality, integrity, and availability of services provided to mobile users. Chen, M., et al. [41] has discussed Software-defined mobile network security (SDMNS), which refers to the security architecture of a mobile network that can be managed through centralized software. It allows network operators to manage and secure the network more efficiently. SDMNS simplifies applying security policies across different mobile networks, nodes, and applications that span the entire mobile service delivery chain. It helps reduce operational costs and allows operators to roll out new services quickly. *Table 1* shows the comprehensive analysis of the related works and *table 2* shows the identified issue from the related works.

Table 1. Comprehensive Analysis

Author	Year	Advantage	Limitations
Zhang, K., et al. [21]	2019	It can provide accurate prediction of the wireless channel behavior, enabling better design and planning of wireless networks	It can be complex, requiring advanced technical expertise and sophisticated tools
Logeshwaran, J., et al. [22]	2023	Optimizes resource allocation for improved performance and cost efficiency compared to traditional decision-making methods.	this model may be its reliance on accurate data and the potential for inaccurate or incomplete information
Qiao, J., et al. [23]	2015	Increased capacity and reduced latency due to the presence of a direct communication path between devices, resulting in improved network performance.	It could be potential interference and limited coverage due to the high frequency and directional nature of millimeter-wave technology
Li, Q. C., et al. [24]	2014	5G allows for more efficient and dynamic allocation of network resources, leading to better network performance and improved overall user experience.	Limited network resources can lead to congestion and slower speeds during peak usage times.
Elayan, H., et al. [25]	2018	Terahertz communication allows for higher data transfer rates and larger bandwidth, enabling faster and more efficient communication	It may include interference from atmospheric moisture and inability to penetrate solid objects
Islam, S. R., et al. [26]	2016	It allows for greater spectral efficiency and better latency by sharing power among multiple users in the same time and frequency resources	Inability to efficiently allocate resources for users with varying signal strengths, leading to reduced system throughput and capacity.
Wang, Y., et al. [27]	2021	The data-driven approach allows for better analysis and optimization of 5G networks for improved performance and user experience.	Without real-world user feedback, the test bed may not accurately reflect the actual performance and challenges of a 5G network.

Giordani, M., et al. [28]	2016	Higher data transfer speeds due to increased spectrum availability and usage, resulting in faster and more efficient network performance.	Limited coverage due to the high frequency nature of mmWave signals, which have difficulty penetrating obstacles
Xiao, M., et al. [29]	2017	Millimeter wave technology allows for increased data transfer speeds, making it ideal for applications that require high bandwidth,	Its limited range and susceptibility to interference from environmental factors such as rain and foliage.
Yaqoob, M., et al. [30]	2021	They can support a variety of different devices with varying bandwidth and coverage requirements, allowing for more flexible and scalable networks.	The use of multiple and diverse technologies may result in compatibility and interoperability issues, leading to difficulty in network management and resource allocation
Wang, D., et al. [31]	2018	The ability to process real-time data from interconnected devices to make informed decisions for improved efficiency and personalized experiences.	The accuracy and reliability of IoT-based intelligent algorithms may be affected by poor connectivity and data privacy concerns.
Giordani, M., et al. [32]	2016	It allowing multiple connections to be established simultaneously, reducing the risk	It may be susceptible to interference and obstacles, resulting in limited coverage and potential drop in connectivity.
Frecassetti, M. G., et al. [33]	2019	Improved data transfer speeds and efficiency due to higher frequency signals used in D-band, leading to faster 5G	high cost of implementation and maintenance.
Gapeyenko, M., et al. [34]	2018	It is improved network coverage and capacity for users in dense urban areas.	It only focuses on mmWave drone base stations and does not consider other types of base stations or technologies.
Ford, R., et al. [35]	2016	The framework provides a comprehensive evaluation of all aspects of 5G mmWave networks, enabling a better understanding of their performance	The framework does not account for all possible environmental factors that may affect 5G mmWave performance in real-world scenarios.
Khan, S. K., et al. [36]	2020	Faster and more reliable data transfer leading to enhanced capabilities for real-time communication	The range of communication between the UAV and ground station may be limited.
Ratasuk, R., et al. [37]	2015	Improved efficiency and reliability of communication between machines can help streamline processes and reduce human error in industrial and business settings.	The limited data transmission rate, which can sometimes be insufficient for certain M2M communication applications.
Busari, S. A., et al. [38]	2017	It allows for a comprehensive analysis of network performance and optimization at a macro level, including potential interference and coverage	Lack of real-world deployment scenarios, leading to potential discrepancies between simulation results and actual network performance.
Zikria, Y. B., et al. [39]	2018	5G mobile services offer significantly faster internet speeds and low latency, making it easier to stream videos, download large files	its limited coverage, as its high frequencies require more infrastructure and can be easily blocked
Fang, D., et al. [40]	2017	It is improved protection against cyber threats and attacks due to stronger encryption	The effectiveness of security measures may vary due to the use of different protocols and technologies by different mobile network providers
Chen, M., et al. [41]	2016	Software-defined mobile networks security allows for centralized management and control of security protocols, improving network efficiency and flexibility.	Software-defined mobile networks security may be vulnerable to attacks from malicious actors with sophisticated hacking techniques.

From the above comprehensive review, the following key issues were identified. They are,

- **Interference:** It is one of the major issues when assessing capacity for communication channels in 5G wireless mobile networks. This is due to the fact that 5G networks are expected to use a larger frequency range than current mobile networks, which increases the chances of interference from other nearby networks.
- **Network Congestion:** It is another issue when assessing capacity for communication channels in 5G wireless mobile networks. With the increased demand on 5G networks, there is a risk of congestion occurring during peak times, leading to decreased capacity.
- **Network:** It is also an important issue when assessing capacity for communication channels in 5G wireless mobile networks. With the increased demand on the network, there is a need for larger and more secure networks, in order to protect user data and prevent any malicious activity.
- **Cost:** It is also an issue when assessing capacity for communication channels in 5G wireless mobile networks. The cost of implementing 5G technology is high, and the cost of maintaining and upgrading equipment can also be quite high, making it difficult to assess the capacity of communication channels.
- **Range:** It is another important issue when assessing capacity for communication channels in 5G wireless mobile networks. The range of 5G networks is limited, making it difficult to assess the capacity of communication channels over a large area.

Table 2. Identified issue from the related works

Author	Network Performance Issues				
	Interference	**Congestion**	**Security**	**Cost**	**Range**
Zhang, K., et al. [21]	✓		✓		
Logeshwaran, J., et al. [22]		✓		✓	✓
Qiao, J., et al. [23]	✓		✓		✓
Li, Q. C., et al. [24]					
Elayan, H., et al. [25]	✓	✓	✓		✓
Islam, S. R., et al. [26]	✓		✓		✓
Wang, Y., et al. [27]		✓	✓	✓	
Giordani, M., et al. [28]	✓		✓	✓	
Xiao, M., et al. [29]		✓	✓	✓	
Yaqoob, M., et al. [30]					
Wang, D., et al. [31]	✓		✓	✓	✓
Giordani, M., et al. [32]	✓	✓	✓		
Frecassetti, M. G., et al. [33]		✓		✓	✓
Gapeyenko, M., et al. [34]	✓		✓	✓	
Ford, R., et al. [35]		✓		✓	✓
Khan, S. K., et al. [36]	✓	✓		✓	✓
Ratasuk, R., et al. [37]		✓	✓	✓	
Busari, S. A., et al. [38]			✓		✓
Zikria, Y. B., et al. [39]	✓	✓			✓
Fang, D., et al. [40]		✓	✓		
Chen, M., et al. [41]	✓	✓	✓		✓

The novelty of the research has listed below,

- The proposed research may introduce a novel mathematical framework or probability model that more accurately predicts the capacity of 5G communication channels. This model could account for dynamic factors such as fading, interference, and user mobility, which are critical in 5G networks.

- The model might incorporate unique 5G features like millimetre-wave (mmWave) frequencies and massive MIMO (Multiple Input, Multiple Output) technologies. This integration would allow for more precise capacity assessment in high-frequency, high-density 5G environments.

- The proposed research could propose a real-time or near-real-time performance evaluation method for 5G channels. This would enable network operators to dynamically optimize resource allocation and improve network efficiency based on current channel conditions.

3. METHODOLOGY

5G mobile services refer to the fifth generation of mobile network technology which is expected to revolutionize the way people use their devices. It promises faster speeds, increased efficiency, and increased bandwidth. 5G promises to provide a seamless user experience over multiple devices, enabling people to enjoy higher quality service with better latency and reliability. As part of this, communication channels must be assessed for their capability and quality to ensure optimal performance. The performance of proposed model has shown in the following *fig.1*.

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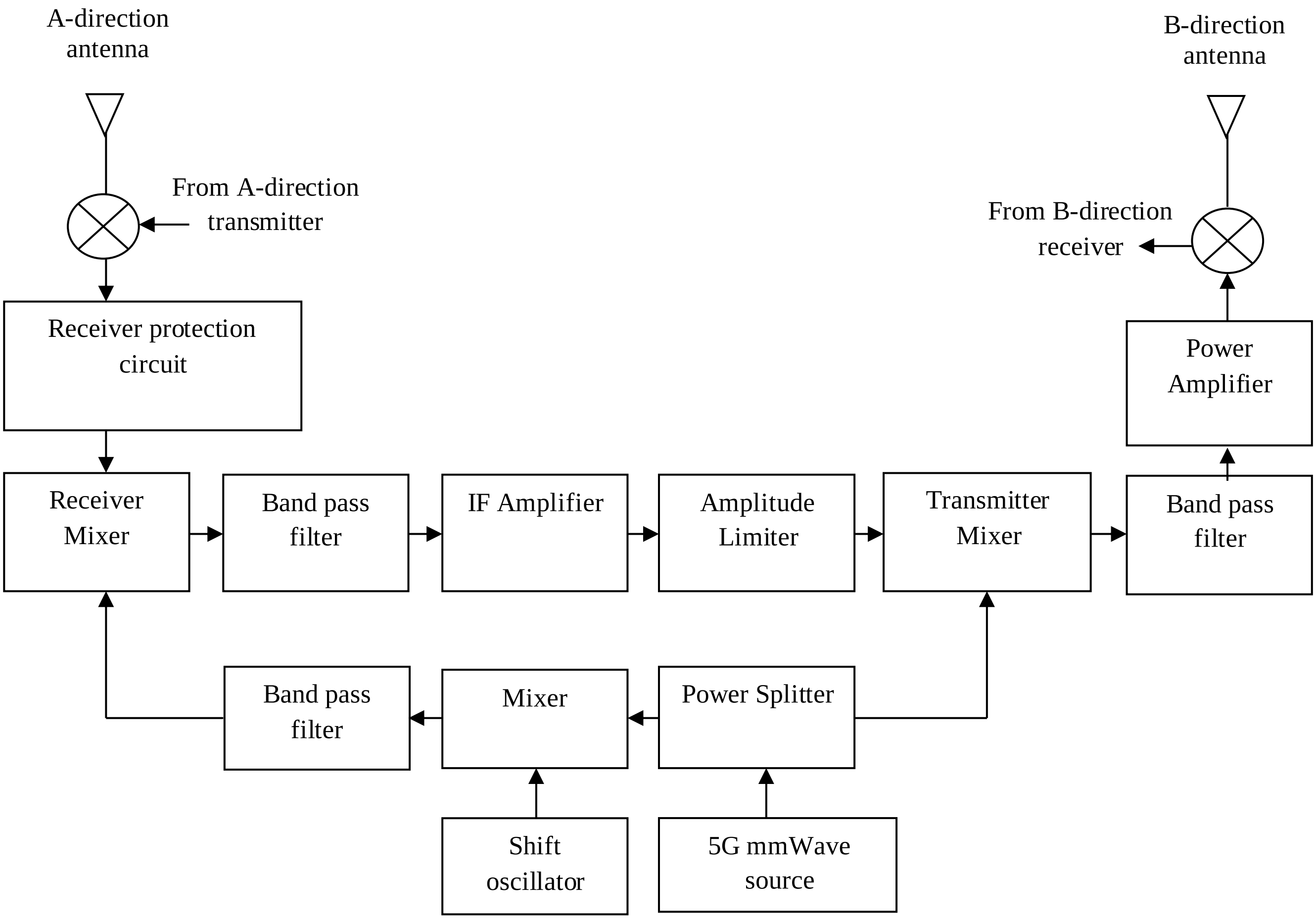

Figure 1. Simplified block diagram of directional communication

Other approaches involve the use of new mobile technologies to improve low-cost, high-speed 5G networks, such as the new 5G New Radio (NR) technology. The proposed model is designed for 5G mmWave applications. It begins with an A-direction antenna that transmits and receives signals, connected to a mixer that combines or separates frequencies. The A-direction transmitter sends signals through a receiver protection circuit to safeguard the system, followed by a receiver mixer that down converts the received signal. A band-pass filter ensures that only the desired frequency range passes through, and an IF amplifier boosts the intermediate frequency signal. The amplitude limiter controls signal strength to prevent distortion. On the transmission side, the transmitter mixer upconverts the signal, which is then filtered by another band-pass filter. A power splitter divides the signal for multiple paths, while a shift oscillator and 5G mmWave source generate the necessary high-frequency signals. The power amplifier boosts the signal before transmission via the B-direction antenna. The B-direction receiver captures incoming signals, completing the bidirectional communication loop. This setup is essential for high-speed, low-latency 5G mmWave communication.

3.1. Proposed Model

The Capacity Assessment Algorithm of communication channels in 5G wireless mobile networks is a process by which the network assesses the amount of data it can send and receive over the channel, taking into account the environment, the available bandwidth, and the network's current capabilities. The algorithm works by monitoring the environment and the network's performance to estimate the amount of data that can be transmitted over the channel without causing performance degradation. This helps the network to determine the maximum rate at which it can send and receive data over the channel. In addition, the algorithm also takes into account the current usage of the channel and the number of users active on the network at any given time. This helps the network to adjust its capacity to match the current demand. The following algorithm 1 expresses the capacity assessment of proposed model.

Algorithm 1: capacity assessment algorithm (CAA)

Input : xi ={xi(1), xi(2), xi(3),……, xi(n)}
Initiate the probability assessment ;
P(xi) =P{xi(1), xi(2), xi(3),……, xi(n)}
Until P(xi) = last P(xi) Do;
For each stream i from 1 to n
For each capacity assessment (Ca) from –r to +r
temp P(xi) = end assessment of capacity factor (C (xi));
temp C(xi) = C(xi)+ Ca;
If (C(xi) < 0 || C(xi) > N)
Then initiate the next capacity assessment from the end capacity factor;

If (Ca > 0)
Then for the probability obtain maximum capacity until a > s
Do temp (a) = max (temp (a), temp (s))
Else for all a < s
Do temp (a) = min (temp (a), temp (s))
End if
Calculate the capacity of the network
If Ca > C(xi)
Then best (C(xi)) = temp (P(xi))
End if
End for each
End for each
End until

The proposed algorithm is designed to assess and optimize the capacity of a communication network, particularly in the context of 5G wireless systems. It begins by taking an input xi ={xi(1), xi(2), xi(3),……, xi(n)}, representing data streams or network parameters. The algorithm initiates a probability P(xi) for the input set, which is iteratively refined until convergence is achieved P(xi) no longer changes). For each stream i from 1 to n, the algorithm evaluates capacity assessments Ca within a range [-r, +r] During each iteration, a temporary probability P (xi) is updated based on the capacity factor C (xi), which is adjusted by Ca. If C (xi) falls outside valid bounds (e.g., less than 0 or greater than a threshold N), the algorithm resets the capacity assessment. The algorithm then distinguishes between positive and negative capacity adjustments. For positive Ca it seeks to maximize capacity by comparing temporary values and selecting the highest. For negative Ca , it minimizes capacity by selecting the lowest. This process ensures that the network capacity is optimized under varying conditions. Finally, the algorithm calculates the overall network capacity and updates the best capacity estimate C(xi) if the current assessment Ca exceeds the previous value. The process repeats for all streams and capacity assessments until the probability assessment converges, ensuring an accurate and optimized capacity evaluation for the network. This approach is particularly suited for dynamic 5G environments, where rapid adjustments are needed to maintain performance.

The capacity assessment algorithm of communication channels in 5G wireless mobile networks is used to estimate the amount of data that can be transmitted through a given communication channel. It is an important tool for network performance analysis and optimization. 5G wireless mobile networks are expected to have a greater capacity than ever to deliver high-speed data services to subscribers. To optimize the capacity of these networks, capacity assessment algorithms are needed to measure the performance of communication channels. The capacity assessment algorithm of 5G wireless mobile networks aims to measure the capacity of the wireless link between a base station and the user device. It involves measuring various parameters, such as the signal level, channel quality, data rate, and delay.

3.1.1. Interference Control
The proposed algorithm determines the maximum amount of data transmitted through a network without causing any interference or congestion. This algorithm controls the network interferences by continuously monitoring the network traffic and adjusting the data transmission rates accordingly. The algorithm evaluates the network's capacity by analyzing the bandwidth and throughput of each network link. It then predicts the expected traffic volume and determines the network's maximum capacity. Then, the algorithm prioritizes and manages the data flow, prioritizing critical and time-sensitive data. It helps prevent network congestion and ensures critical data is transmitted without delay. It also implements techniques such as traffic shaping, where data is queued and transmitted in a controlled manner, and data compression, which reduces the amount of data transmitted to avoid overloading the network. Finally, the algorithm also monitors network performance in real-time and adjusts the data transmission rates to avoid network interferences and maintain a stable network environment.

3.1.2. Congestion Control
The proposed algorithm has rules and techniques for monitoring and managing traffic flow in a network. It continuously evaluates the capacity of the network and its components to ensure optimal performance and prevent congestion. One way the capacity assessment algorithm controls congestion is by constantly monitoring the network for potential bottlenecks or areas of high utilization. It uses this information to adjust data routing, redirecting it through less congested paths to balance the traffic flow. It also considers the current and predicted network load to allocate resources and proactively prevent overloading. Intelligently distributing the resources across the network helps ensure that all nodes operate within their capacity limits and avoid potential congestion. The algorithm can employ priority queuing and flow control techniques to manage data flow and prevent data overload in certain network parts. It helps maintain an even traffic distribution and prevents any one node from becoming overwhelmed.

3.1.3. Security Management
The capacity assessment algorithm is designed to identify and analyze a system's organizational and technical capabilities to determine its current and potential capacity to handle specific workloads. In order to effectively manage security issues, the algorithm considers several factors that impact a system's overall capacity. The algorithm evaluates the existing security mechanisms and protocols to protect the system from external threats. It also assesses the effectiveness of these measures and identifies any potential vulnerabilities or weaknesses that need to be addressed. The algorithm considers the expertise and training level of the system administrators and personnel responsible for managing the system's security. It evaluates their understanding of security best practices and ability to respond to and handle security incidents. The algorithm considers the system's physical and network infrastructure and assesses whether it meets industry security standards. It includes server location, access controls, and network segmentation.

3.1.4. Network Cost Management
The proposed algorithm is a tool used in network management to optimize the utilization of network resources and minimize

associated costs. It analyzes the current network congestion, traffic patterns, and resources to determine the best resource allocation. One of the primary ways the algorithm manages the network cost is by identifying bottlenecks and optimizing the resources in those areas. It means that the algorithm allocates more resources to areas with higher demand and less to areas with lower demand, reducing the overall cost of resources. It also considers the type of traffic being carried on the network and allocates resources accordingly. For example, it may prioritize time-sensitive traffic, such as voice calls, over data traffic, as this can help reduce the cost of delay-sensitive services. The algorithm can also identify potential failures or outages and reroute traffic to avoid costly downtime. This proactive approach helps minimize the impact of network failures and reduces the associated costs.

3.1.5. Network Coverage Management

The capacity assessment algorithm is a crucial tool in managing network coverage. It helps calculate the total capacity the network can handle, considering factors such as population density, mobile device penetration, and available bandwidth. The algorithm manages network coverage by identifying areas with high demand for network services. It can estimate the expected traffic and capacity requirements by analyzing population density and the number of mobile devices in a particular region. This information can then be used to determine the optimal placement of cell towers and network equipment to ensure coverage for all users in the area. The algorithm can monitor the network usage in real-time and adjust the network capacity as needed. For instance, during events or peak usage hours, it can allocate more resources to areas with higher demand, ensuring uninterrupted network service for users. Moreover, the capacity assessment algorithm also considers the available bandwidth in a specific area. It ensures that the network is not overloaded and can handle the expected traffic load without compromising the quality of service.

The capacity of the link is then calculated based on the collected data. The capacity assessment algorithm of 5G wireless mobile networks can be divided into two distinct phases. The first phase is the physical layer assessment. During this phase, the capacity assessment algorithm measures the wireless link's signal level, channel quality, and data rate. The signal level is determined by measuring the signal strength of the transmitted signal. The channel quality is measured using the signal-to-noise ratio of the received signal. The data rate is determined by measuring the link latency and the amount of data that can be transmitted in a given period. The second phase of the capacity assessment algorithm is the application layer assessment. During this phase, the algorithm measures the link's throughput, the delay, and the packet loss rate. The throughput is calculated by measuring the data transmitted in a given period. The delay is determined by measuring the time it takes for the transmitted data to reach the destination. The packet loss rate is determined by measuring the number of packets lost during transmission. The capacity assessment algorithm of 5G wireless mobile networks is essential for ensuring the network's performance. By measuring the various parameters of the wireless link, the algorithm can determine the best possible data rate for a given user. It ensures the user can experience high-speed data services without delays or packet losses.

4. ANALYTICAL DISCUSSION

The capacity assessment of communication channels for 5G wireless mobile networks determines the number of users a network can support at any given time. It is done by analyzing the network’s throughput, spectrum availability, and other parameters that can affect the speed and reliability of the network. The capacity assessment is essential for network operators to determine the number of users they can accommodate with their available bandwidth. It can help operators plan their networks better and optimize their services. Additionally, the capacity assessment can help operators understand the peak and off-peak periods of their networks and the types of services best suited for each situation. It helps operators plan for and configure their networks accordingly. Directional communication is essential because it helps ensure that messages are sent and received quickly and accurately, allowing for quick and effective decision-making and problem-solving.

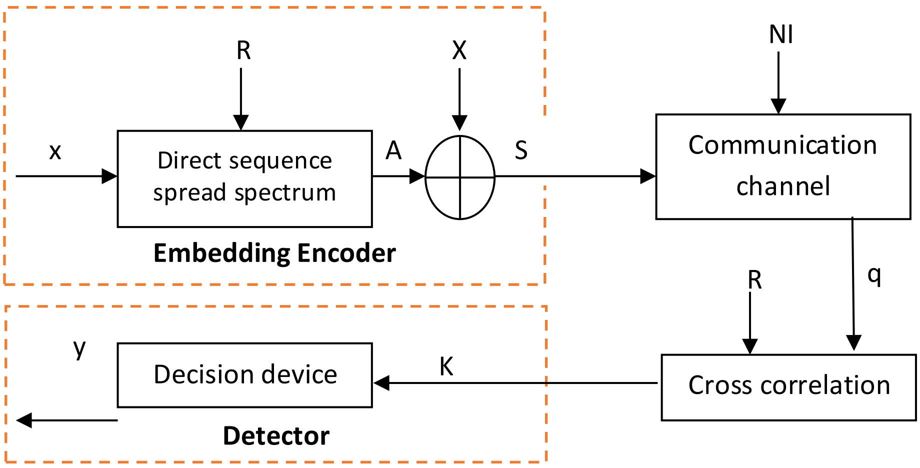

Figure 2. Capacity assessment of communication channels

Fig.2 shows the capacity assessment of communication channels including the detector and encoder and communication channels. Spread spectrum capacity assessment of communication channels for 5G wireless mobile networks is the process of determining the capacity of a communication channel based on the modulation and coding technique used. This process is used to determine the maximum data rate that can be achieved on a given channel and the maximum number of users that can be supported. It is a critical technology in 5G wireless mobile networks, enabling reliable, high-speed, and low-latency communications deployment. The communication channel has the initial bandwidth (x) of the process. The spectrum allocation can decide by the sequential signal (R), the interference monitoring has obtained with the help of masking signal (A). Let's consider the P is a zero mean periodic binary sequence with a chip-shaped noise lie waveform. Direct sequence (DS) method is used to spread the spectrum:

$$B = \max_{u(w,i/o)} [E(W;T) - E(W;D)] \quad (1)$$

Where T indicates the signal that has been received by the detector, D the signal that has been broadcast, W the auxiliary random variable, and E(.) the mutual information function. The capacity of the channel has indicated in *eq.2*.

$$B = \frac{1}{2}\log_2(1+SNR) \quad (2)$$

Where, SNR represents the Signal to noise ratio.

$$A_i = x_i * R \quad (3)$$

The 'i^{th}' vector of A has illustrated as $A_i=\{a_i(1), a_i(2), a_i(3),\ldots\ldots, a_i(n)\}$ and the vector of P has illustrated as $R=\{r(1), r(2), r(3),\ldots\ldots, r(n)\}$. The total period has computed with the help of *eq.4*.

$$X = \left\{\frac{H_r}{H_x}\right\} \quad (4)$$

Where, H_r indicates the resource rate and H_m indicates the transfer bit rate,

$$S_i = M_i + A_i \quad (5)$$

Where, H_r indicates the host signal and the 'i^{th}' vector of M has illustrated as $M_i=\{m_i(1), m_i(2), m_i(3),\ldots\ldots, m_i(n)\}$. Now the extraction of resource has the following,

$$K = \frac{1}{X}\{R_a * R_b\} \quad (6)$$

$$K = \frac{1}{X}\sum_{i=1}^{n} r_a(i) * r_b(i) \quad (7)$$

In *eq.7*, a and b are the different capacity vectors. Now the estimation of correlation between the communication channels with noiseless function has the following,

$$K_i = \frac{1}{X}\{q_i * R^t\} \quad (8)$$

$$K_i = \frac{1}{X}\{(M_i + A_i) * R^t\} = K_{im} + K_{ia} \quad (9)$$

$$K_{im} = \frac{1}{X}\sum_{s=1}^{n} m_i(s) * r(s); K_{ia} = \frac{1}{X}\sum_{s=1}^{n} a_i(s) * r(s); \quad (10)$$

Now, substitute the values of *eq.10* in *eq.9*

$$K_i = K_{im} + K_{ia} = \frac{1}{X}\sum_{s=1}^{n} m_i(s) * r(s) + \frac{1}{X}\sum_{s=1}^{n} a_i(s) * r(s) \quad (11)$$

$$K_i = \frac{1}{X}\left\{\sum_{s=1}^{n} m_i(s) * r(s) + \sum_{s=1}^{n} a_i(s) * r(s)\right\} \quad (12)$$

$$K_i = \frac{1}{X}\left\{\sum_{s=1}^{n} (m_i(s) * r(s)) + (a_i(s) * r(s))\right\} \quad (13)$$

Spread spectrum capacity assessment is essential for ensuring that the capacity of the communication channel is adequate to meet the needs of the 5G applications. The assessment includes assessing the interference levels, the noise levels, the signal-to-interference ratio, and the modulation technique used. It also involves estimating the number of users that can be supported by the communication channel and determining the bandwidth that can be allocated to each user. Finally, it involves detecting and mitigating any unexpected errors during the communication process. All of these aspects are essential for ensuring that the communication channel can support 5G applications and provide the highest quality of service. The capacity assessment includes evaluating various factors such as channel conditions, interference, throughput, and other aspects of the communication channel. It is essential for 5G wireless mobile networks, allowing operators to accurately plan their network capacity and determine the optimal modulation and coding technique for the available communication channels. Spread spectrum is a wireless communication technology that allows multiple users to share a single communication channel while reducing interference and maximizing system capacity.

5. COMPARATIVE ANALYSIS

The proposed performance probability model (PPM) has compared with the existing non-orthogonal multiple access (NOMA), Millimeter wave channel modeling (MWCM) and Smart Load-Based Resource Optimization Model (LROM). Here the Network Simulator (NS-3) is the simulation tool used to execute the results. Also, a wireless network dataset [42] used here to execute the results. The *table 3* expresses the simulation setup.

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Table 3. Simulation setup

PARAMETER	VALUE
Model spot	750m*750m
Frame break duration	25 sec
Data rate (Tx)	40 Mbps
Interference detection rate (IDR)	20 ms
Capacity allocation duration	15 ms
Channel bandwidth	450 GHz
Carrier frequency	15.8 MHz

5.1. Computation of Data Rate (DR)

The data rate of capacity assessment algorithms for communication channels in 5G wireless mobile networks depends on several factors, including the type of channel, the type of modulation used, the number of antennas, the signal-to-noise ratio, the channel bandwidth, and the modulation coding rate. The data rate can be calculated by taking all of these factors into account and then applying the Shannon-Hartley theorem.

$$DR = \{C_b * \log_2(1 + SNR)\} \tag{14}$$

Where, DR indicates the data rate, C_b represents the channel bandwidth and SNR is the signal to noise ratio. For example, for a single-input single-output (SISO) system with a signal-to-noise ratio of 10 dB and a channel bandwidth of 1 GHz, the achievable data rate can be calculated as:

$$\text{Data rate} = (1\text{GHz}) \log_2 (1 + 10) = 6.6 \text{ Gbps} \tag{15}$$

The achievable data rate can also be calculated for multiple-input multiple-output (MIMO) systems. In a 2x2 MIMO system with a signal-to-noise ratio of 10 dB and a channel bandwidth of 1 GHz, the achievable data rate can be calculated as:

$$\text{Data rate} = (1\text{GHz}) \log_2 (1 + 10\text{^}2) = 13.2 \text{ Gbps} \tag{16}$$

Table 4 provides the various comparison of data rate (in %) between the existing and proposed model.

Table 4. Comparison of data rate (in %)

Inputs	NOMA	MWCM	LROM	PPM
100	68.93	59.93	80.53	83.03
200	70.90	62.35	82.73	85.02
300	72.03	62.76	83.53	86.22
400	73.72	64.51	85.26	87.95
500	75.27	65.92	86.76	89.54
600	76.82	67.34	88.26	91.14
700	78.37	68.75	89.76	92.74

In a comparison range, the proposed PPM achieved 87.95% data rate. Meanwhile the existing NOMA reached 73.72%, MWCM obtained 64.51% and LROM reached 85.26% data rate. *Fig.3* shows the data rate comparison between the existing and proposed models.

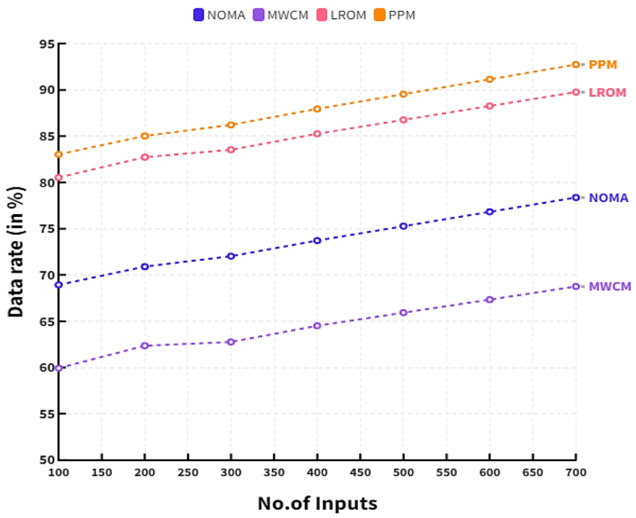

Figure 3. Comparison of data rate

The achievable data rate can be further increased by using higher order modulation schemes and advanced coding schemes. For example, using 256-QAM modulation and a coding rate of 1/3, the achievable data rate in the above example can be increased to 22.3 Gbps. In addition to these factors, the achievable data rate will also depend on the physical environment, such as the presence of obstacles, other users, etc. Therefore, the data rate of capacity assessment algorithms in 5G wireless mobile networks can vary depending on the specific conditions.

5.2. Computation of Scalability (S)

The scalability of a capacity assessment algorithm for communication channels in 5G wireless mobile networks can be determined by its ability to effectively provide a consistent quality of service (QoS) across different network configurations. The scalability of the algorithm depends on factors such as the number of users, the size of the network, the number of base stations, the number of channels, and the type of traffic. The capacity assessment algorithm should be able to adapt to various network conditions and configurations, including changes in user devices, the number of users, the bandwidth requirements, and the type of traffic. It should also be able to handle varying levels of interference, interference from other networks, changes in the environment, and dynamic changes in the traffic patterns. The scalability of the network has computed with the help of *eq.17*.

$$S = \left\{ \frac{T(n)}{T(i)} \right\} \tag{17}$$

Where, *S* indicates the scalability of the networks, *T(n)* denotes the throughput of 'n' *th* load and *T(i)* denotes the throughput of initial load. The scalability of the algorithm can be evaluated by examining its performance in various network configurations. For example, the algorithm should be able to handle a large number of users and provide a consistent QoS across all users. It should also be able to handle different types of traffic, such

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as video streaming, voice calling, and data transmission. *Table 5* provides the various comparison of scalability (in %) between the existing and proposed model.

Table 5. Comparison of scalability (in %)

Inputs	NOMA	MWCM	LROM	PPM
100	75.27	65.93	86.76	89.54
200	76.82	67.34	88.26	91.14
300	78.37	68.76	89.76	92.73
400	79.92	70.17	91.26	94.33
500	81.47	71.59	92.76	95.92
600	83.02	73.00	94.26	97.52
700	84.57	74.42	95.76	99.11

In a comparison range, the proposed PPM achieved 94.33% scalability. Meanwhile the existing NOMA reached 79.92%, MWCM obtained 70.17% and LROM reached 91.26% data rate. *Fig.4* shows the scalability comparison between the existing and proposed models.

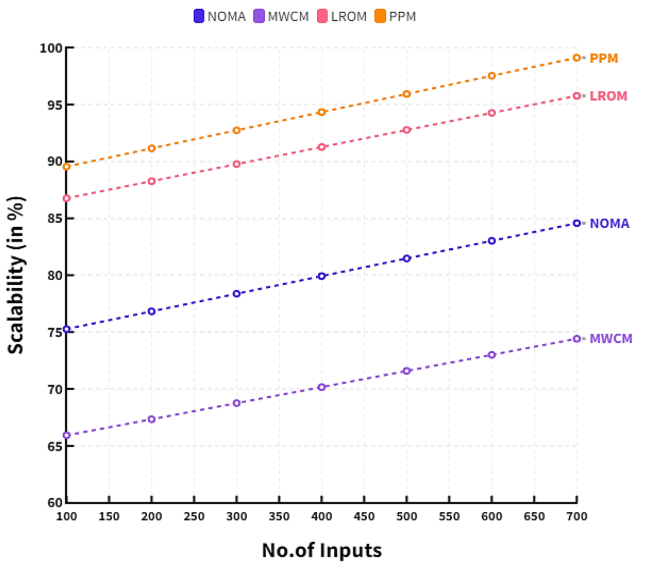

Figure 4. Comparison of scalability

The scalability of the algorithm should also be evaluated in terms of its ability to handle peak traffic loads. Peak traffic loads can occur when a large number of users are sending data at the same time or when traffic is concentrated in a specific area. The algorithm should be able to handle these peaks without significant performance degradation. The algorithm should be able to provide a consistent QoS across multiple devices and networks. This requires that the algorithm be able to adapt to changes in the network topology, user devices, and the type of traffic. This will help ensure that the capacity assessment algorithm can provide a consistent QoS across a variety of networks and devices.

5.3. Computation of Latency (L)

The latency of the capacity assessment algorithm for communication channels in 5G wireless mobile networks depends on several factors, such as the type of network, the traffic pattern, the number of users, and the available bandwidth. The latency of the capacity assessment algorithm can be estimated by analyzing the time it takes for a packet to traverse the network from the source to the destination. This latency can be further determined based on the transmission control protocol (TCP) round-trip time (RTT). The RTT includes all the delays associated with the network, such as the processing delays, queuing delays, and transmission delays. The latency of the capacity assessment algorithm can also be estimated by measuring the time it takes for the algorithm to calculate the available capacity of a given communication channel. This can be done by measuring the time it takes for a packet to traverse the communication channel from the source to the destination. *Table 6* provides the various comparison of latency (in %) between the existing and proposed models.

Table 6. Comparison of latency (in %)

Inputs	NOMA	MWCM	LROM	PPM
100	73.16	64.36	84.20	86.70
200	73.61	66.68	85.63	88.13
300	74.06	69.00	87.06	89.56
400	74.51	71.32	88.49	90.99
500	74.96	73.64	89.92	92.42
600	75.41	75.96	91.35	93.85
700	75.86	78.28	92.78	95.28

In a comparison range, the proposed PPM achieved 90.99% latency. Meanwhile the existing NOMA reached 74.51%, MWCM obtained 71.32% and LROM reached 88.49% latency. *Fig.5* shows the latency comparison between the existing and proposed models.

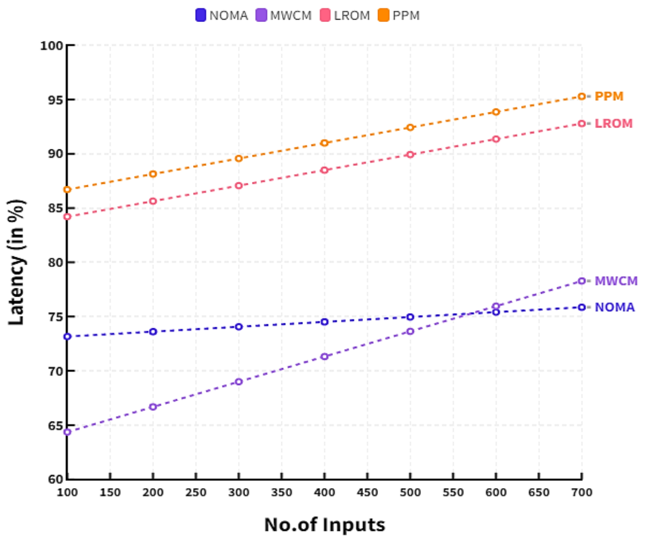

Figure 5. Comparison of latency

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The latency of the capacity assessment algorithm can also be calculated by measuring the time it takes for the algorithm to carry out its computations, such as the calculation of the capacity and the channel assignment. This can be done by measuring the time it takes for the algorithm to process a given set of data. The latency of the capacity assessment algorithm for communication channels in 5G wireless mobile networks depends on the type of network, the traffic pattern, the number of users, and the available bandwidth. The latency can be estimated by measuring the time it takes for a packet to traverse the network, the RTT, and the time it takes for the algorithm to process a given set of data.

5.4. Computation of Signal Strength (SS)

The signal strength of capacity assessment algorithms for communication channels in 5G wireless mobile networks is determined by a variety of factors. These include the type of modulation used, the bandwidth of the channel, the signal-to-noise ratio (SNR), the antenna type, and the environment in which the communication is taking place. For example, an advanced modulation technology such as Orthogonal Frequency Division Multiplexing (OFDM) can provide greater signal strength than a simpler modulation technique such as Quadrature Amplitude Modulation (QAM). Similarly, wider channels with higher data rates will provide stronger signals than narrow ones with lower data rates. The SNR of the communication link is also an important factor in determining the signal strength. A higher SNR will result in a stronger signal. Additionally, different types of antennas can provide different levels of signal strength. For example, directional antennas will focus the signal towards a specific direction and provide greater signal strength than Omni-directional antennas. *Table.7* provides the various comparison of signal strength (in %) between the existing and proposed model.

Table 7. Comparison of signal-strength (in %)

Inputs	NOMA	MWCM	LROM	PPM
100	75.06	60.93	86.72	86.29
200	75.54	63.66	87.20	88.06
300	76.02	66.39	87.68	89.83
400	76.50	69.12	88.16	91.60
500	76.98	71.85	88.64	93.37
600	77.46	74.58	89.12	95.14
700	77.94	77.31	89.60	96.91

In a comparison range, the proposed PPM achieved 91.60% signal strength. Meanwhile the existing NOMA reached 76.50%, MWCM obtained 69.12% and LROM reached 88.16% signal strength. *Fig.6* shows the signal strength comparison between the existing and proposed models.

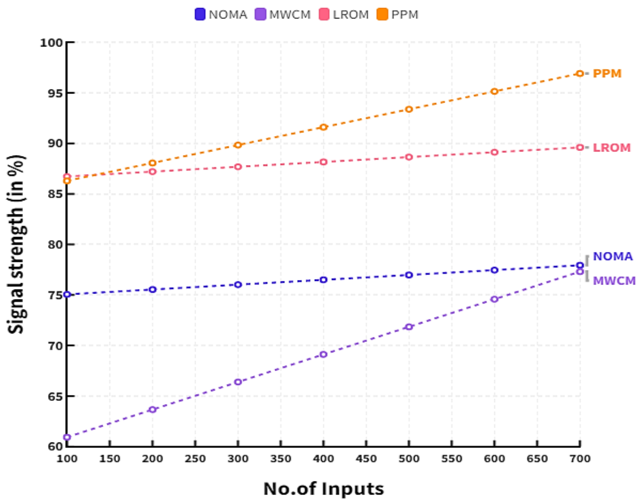

Figure 6. Comparison of signal strength

The environment in which the communication is taking place can also affect the signal strength. For example, the presence of obstacles such as walls or trees can reduce the signal strength. In addition, radio frequency interference from other sources can also reduce the signal strength. The signal strength of capacity assessment algorithms for communication channels in 5G wireless mobile networks is determined by a variety of factors such as the modulation technique, the channel bandwidth, the SNR, the antenna type, and the environment in which the communication is taking place.

5.5. Computation of Bandwidth assessment (BA)

Bandwidth utilization is an important metric in 5G wireless mobile networks, as it provides insight into the efficiency with which network resources are being utilized. It is important for network operators to monitor this metric and ensure that the network is operating optimally. The most common method of calculating bandwidth utilization of communication channels in 5G wireless mobile networks is the "Throughput" method. This method is based on the amount of data that can be transmitted in a given period of time. The higher the throughput, the more efficient the network is utilizing its resources. To calculate the throughput, the total data transmitted in a given period of time is divided by the total bandwidth available. This value is then multiplied by 100 to obtain the percentage of bandwidth utilization. *Table.8* provides the various comparison of bandwidth assessment (in %) between the existing and proposed model.

Table 8. Comparison of bandwidth assessment (in %)

Inputs	NOMA	MWCM	LROM	PPM
100	83.47	52.45	84.06	89.90
200	82.97	52.45	82.97	89.64
300	82.22	51.62	81.83	89.07
400	82.22	52.35	82.19	90.21
500	81.60	51.94	81.08	89.80
600	81.15	51.82	80.40	89.83
700	80.70	51.71	79.73	89.87

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In a comparison range, the proposed PPM achieved 90.21% bandwidth assessment. Meanwhile the existing NOMA reached 82.22%, MWCM obtained 52.35% and LROM reached 82.19% bandwidth assessment. *Fig.7* shows the bandwidth assessment comparison between the existing and proposed models.

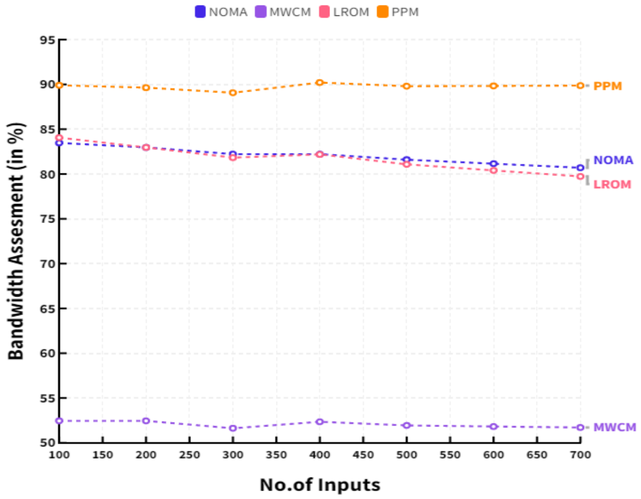

Figure 7. Comparison of bandwidth assessment

In addition to the throughput method, there are a number of other methods available to measure bandwidth utilization in 5G wireless mobile networks. These include packet loss rate, signal-to-noise ratio, and latency. By monitoring these metrics, network operators can better understand how their network is performing and identify areas for improvement.

5.6. Computation of Reliability (R)

5G wireless mobile networks rely on a variety of communication channels, including radio frequency (RF) signals, optical fibers, satellite links, and microwave connections. Each of these channels has its own unique reliability characteristics. RF signals are the most commonly used form of communication and they boast the highest levels of reliability due to the fact that they can travel through walls and other obstacles. However, they are subject to interference from other devices and environmental factors. *Table 9* provides the various comparison of reliability (in %) between the existing and proposed model.

Table 9. Comparison of reliability (in %)

Inputs	NOMA	MWCM	LROM	PPM
100	83.27	53.46	83.72	91.23
200	83.55	53.86	84.36	91.47
300	82.83	53.29	83.78	90.82
400	82.78	53.37	84.01	90.76
500	82.56	53.28	84.04	90.56
600	82.34	53.20	84.07	90.35
700	82.12	53.11	84.10	90.15

In a comparison range, the proposed PPM achieved 90.76% reliability. Meanwhile the existing NOMA reached 82.78%, MWCM obtained 53.37% and LROM reached 84.01% reliability. *Fig.8* shows the reliability comparison between the existing and proposed models.

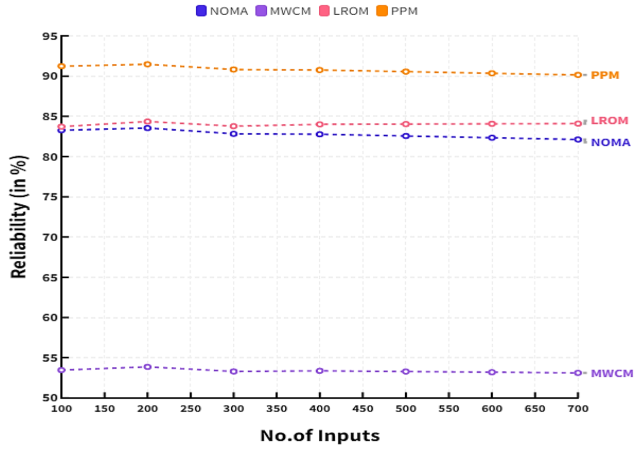

Figure 8. Comparison of reliability

Optical fibers are highly reliable due to the fact that they are immune to interference and have low latency. However, they are expensive to install and maintain, making them impractical for most applications. Satellite links provide reliable communication over long distances, but they experience high latency and are vulnerable to weather conditions. Microwave connections are relatively inexpensive and provide reliable communication over short distances. However, they are vulnerable to interference from other devices and environmental factors. *Table 10.* shows the overall performance comparison.

Table 10. Overall performance comparison

Parameters	NOMA	MWCM	LROM	PPM
Data rate (DR)	73.72	64.51	85.26	87.95
Scalability (S)	79.92	70.17	91.26	94.33
Latency (L)	74.51	71.32	88.49	90.99
Signal Strength (SS)	76.50	69.12	88.16	91.60
Bandwidth assessment (BA)	82.22	52.35	82.19	90.21
Reliability (R)	82.78	53.37	84.01	90.76

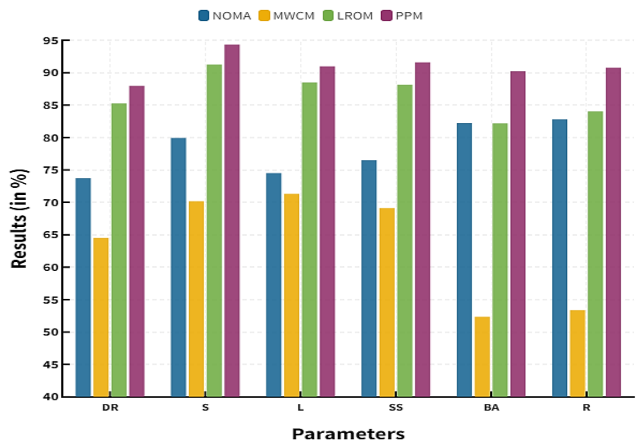

Figure 9. Overall performance comparison

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Figure 9 shows the overall performance comparison. The network's power requirements must be considered to ensure that the network can operate efficiently and reliably. The capacity assessment of communication channels in 5G networks is a complex task that requires a detailed analysis of the network architecture and its components. The proposed PPM achieved 87.95% data rage, 94.33% scalability, 90.99% latency, 91.60% signal strength, 90.21% bandwidth assessment and 90.76% reliability. Understanding the network's characteristics and components is essential to assess its capacity accurately. Furthermore, assessing the capacity of communication channels in 5G networks must consider the evolving nature of the network as new technologies and applications are developed and deployed. The capacity assessment of communication channels in 5G networks is an essential factor in determining the network's overall performance. The assessment must include a detailed analysis of the network architecture and its components and take into account the evolving nature of the network. Furthermore, the network's power requirements must also be considered to ensure that the network can operate efficiently and reliably.

In 5G wireless mobile networks, the capacity assessment algorithm is used to determine the maximum data rate that can be achieved in a given communication channel. It takes into account the physical layer characteristics of the wireless medium, such as the signal-to-noise ratio, the number of antennas, and the modulation and coding scheme. By analyzing these factors, the algorithm can accurately estimate the achievable data rate for the given communication channel. By doing so, the network can be optimized for better performance. The capacity assessment algorithm can also be used to evaluate the impact of external factors such as interference and fading on the achievable data rate. This can be used to fine-tune the network design and maximize the data rate. The capacity assessment algorithm can be improved by leveraging various techniques, such as channel quality estimation, channel modeling, and interference estimation. Additionally, predictive analytics can be used to determine the optimal capacity of the network. By implementing these techniques, the algorithm can better predict the capacity of the network in order to maximize communication channels in 5G wireless mobile networks. These techniques can also help to optimize the network for better coverage, higher throughput, and improved user experience. Through predictive analytics, the algorithm can monitor user activity and traffic patterns to identify areas with heavy traffic and optimize the network accordingly. Additionally, by leveraging machine learning, the algorithm can learn from past traffic patterns and user behavior to provide more accurate capacity assessments. By leveraging these techniques, the capacity assessment algorithm can reach better performance and maximize communication channels in 5G wireless mobile networks.

6. CONCLUSIONS

The capacity assessment of communication channels in 5G wireless mobile networks is a critical component of the network's overall performance. The capacity of communication channels in 5G networks is determined by the number of users that can be supported simultaneously and the amount of data that can be transmitted or received within a given time frame. The capacity of communication channels in 5G networks has been enhanced through advanced antenna technologies, higher-order modulation schemes, beam forming techniques, and spectrum sharing. These technologies have allowed for the efficient use of the radio spectrum, improved coverage of the network, and reduced interference. Furthermore, the use of multiple inputs multiple output (MIMO) antennas has increased the capacity of communication channels, allowing for more data to be transmitted or received within a given time frame. In order to assess the capacity of communication channels in 5G networks, various parameters must be considered. These include the number of users that can be supported simultaneously, the data rate that can be achieved, the amount of interference, and the latency of the network. The proposed PPM achieved 87.95% data rage, 94.33% scalability, 90.99% latency, 91.60% signal strength, 90.21% bandwidth assessment and 90.76% reliability. The future scope of capacity assessment algorithms for communication channels in 5G wireless mobile networks is to provide more efficient and reliable communication services. These algorithms will enable operators to assess the capacity of their channels more accurately and quickly, allowing them to optimize their networks and services better. Additionally, the algorithms can be used to analyze the performance of the 5G network over time, enabling operators to adjust the network parameters accordingly. It can improve the overall user experience and provide faster connection speeds. Furthermore, these algorithms can be applied to analyze the quality of service (QoS) of the 5G networks, enabling operators to adjust the bandwidth allocation and other parameters to meet customer expectations better. Finally, these algorithms can be used to improve the security of the 5G networks, such as detecting threats and identifying malicious activities.

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