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THOMSON REUTERS
[Shagufta et al., 8(4), Apr 2023]

ISSN : 2455-9679
SJIF Impact Factor : 6.008

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IJRTSM

INTERNATIONAL JOURNAL OF RECENT TECHNOLOGY SCIENCE & MANAGEMENT

“ IMPROVEMENT OF 5G NETWORK COVERAGE AND CAPACITY BY NOMA AND DISTRIBUTED BASE STATION ARCHITECTURE”

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ABSTRACT

The emergence of 5G technology has brought new challenges to the wireless communication industry, such as the need for higher capacity and coverage. Millimeter wave (mmWave) technology, which operates at frequencies above 24 GHz, is a promising solution to meet these demands due to its wider bandwidth and higher data rates. However, mmWave signals have limited range and are prone to blockage by obstacles, which can affect coverage and capacity. The implementation of 5G networks has been gaining momentum, but there are still some challenges that need to be addressed, such as providing sufficient coverage and capacity. One solution to this problem is the use of millimeter wave (mmWave) frequencies, which offer high bandwidth and low latency, but have limited coverage compared to lower frequency bands. In this work the distributed base station architecture (DBSA) has emerged as a promising approach to improve coverage and capacity in mmWave 5G networks. DBSA consists of a large number of low-power base stations, deployed in a dense and coordinated manner, which allows for better coverage and capacity through spatial reuse and interference management. To address these issues, distributed base station architecture is proposed in this work. The architecture involves deploying multiple base stations, which are smaller in size and located closer to the users, to improve coverage and capacity. Additionally, Non-Orthogonal Multiple Access (NOMA) techniques are used to improve the spectral efficiency of the system. NOMA is a multiple access technique that allows multiple users to share the same time and frequency resources by using superposition coding and successive interference cancellation (SIC) decoding. This technique can improve the spectral efficiency of the system and increase the number of users that can be served simultaneously. Simulation results show that the proposed architecture with NOMA techniques can significantly improve the coverage and capacity of mmWave 5G networks. The system can achieve up to 100% coverage in urban areas and increase the system capacity by up to 300% compared to traditional orthogonal multiple access (OMA) techniques. The proposed architecture can also reduce the outage probability and increase the user and throughput and overall performance of the proposed approach.

Key Words: *distributed base station architecture (DBSA), 5G networks, millimeter wave, NOMA.*

I. INTRODUCTION

The industrial world is emerging around the concept of "smart cities" as the trend toward the creation of smart objects grows [1].The term "smart cities" refers to the topic of a community's or region's utilization and deployment of technology that decides how frequently power is required and what production ratio may be achieved. Climate and atmosphere are affected by the concept of a smart city. Pollutants produced by industrial or instrument materials are a major problem for smart city architects. The ever-increasing populations and territorial boundaries of cities and towns frequently contribute significantly to human contact, influencing the daily activities of their inhabitants [2].To achieve this incredibly complex set of requirements, 5G networks of the future would require revolutionary breakthrough technology. Moreover, unlike its predecessors, 5G is designed to be interoperable with Wi–Fi, UMTS, and LTE, which is anticipated to be a vital component of its ecosystem. This will demand a paradigm shift in cellular network design. Demand for cutting-edge technologies has been bolstered by academics and business, mobile telephony providers, and users of this technology (including those who are continuously striving to enhance their own skills and those of their clients). Numerous European projects, such as METIS, One5G, Fabulous 5G, MCN, etc., have been explored in recent years to promote the development of 5G wireless networks. Numerous scholarly works have also addressed this topic in their research. Many technologies have been determined to be essential by our investigation [3].

The Evolution of Cellular networks-Wireless communication has helped to the economic and social development of both industrialized and developing nations during the past decade. Massive numbers of people around the world have incorporated wireless technologies into their daily lives, a trend that is anticipated to continue. Beginning with the initial wave of analog mobile networks in 1979 and culminating in the most recent 4G, cellular networking systems have evolved over time. LTE was introduced in the 2010s and has since been implemented globally in stages. LTE has solidified its position as the dominant mobile standard [4].

About every ten years, a new generation of wireless communication networks is introduced globally, as shown in Figure 1. Each generation is usually used for an extended period and reaches its subscriber height. For instance, 2G GSM is still extensively implemented on a global scale. On the other hand, a distinct tendency may be seen in Japan's more developed market: As is customary in sophisticated mobile communication markets, each generation reaches its peak around ten years after its original introduction. This implies that the subscriber base and coverage area of each new-generation system have grown quickly in response to increased consumer demand, as well as rapid migration from legacy to new technology. Thus, in Japan, 1G and 2G were phased out 20 years after their introduction, despite the fact that their maxima were only being achieved on a global scale! Notably, such a developed market enables technologies to eventually enter the global market.[5-6]

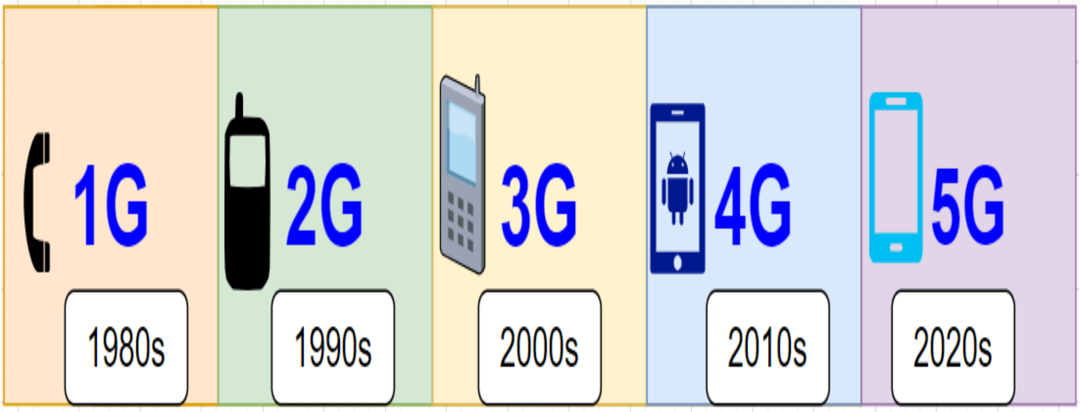

Figure 1: Progression of mobile technology.

Prior to 4G, a solid systems concept and technologies for future generations developed very immediately after the commercial launch of the previous generation. The consequence was the implementation of 2G (TDMA: Time Division Multiple Access), 3G (CDMA: Code Division Multiple Access), and 4G (OFDMA: Orthogonal frequency Division Multiple Access) systems [5] Despite the fact that nobody intended to use the term "4G," a 4G solution (OFDMA) was created in the early 2000s. However, despite the fact that everyone is talking about 5G these days, there is no specific implementation of it. Thus, the current condition of 5G differs from that of 4G a decade ago. This does not imply that 5G innovations do not exist; rather, it indicates that there are numerous viable answers. OFDMA-based wireless systems remain a prominent contender among them. Despite the fact that 4G radio access has nearly attained Shannon capability at the link level, specialists in this sector think that radio system development has reached a point of saturation. Yet, innovative technological arrangements will continue to supply innovative technological responses for the development of new use cases. In the 5G era, commencing in 2020 and beyond, activities that are currently unthinkable will become realizable. In the past, higher frequency ranges (beyond 6GHz) have been regarded unsuitable for cellular networks. Hence, effective exploitation of higher frequency ranges is now viewed as a crucial component of

5G in order to accommodate the predicted traffic growth. Innovative technological advancements, such as the use of higher frequency ranges with bigger bandwidths, will enable the provision of superior mobile service options.[7]

5G mmWave Spectrum-The huge demand for wireless data bandwidth doesn't look like it will slow down any time soon. At the same time, users' experiences with mobile data continue to grow and change, which puts more pressure on networks to use the entire available wireless spectrum. With this expected growth in mind, the cell phone industry looked at other frequency bands that could possibly be used in the development of new 5G wireless technologies.

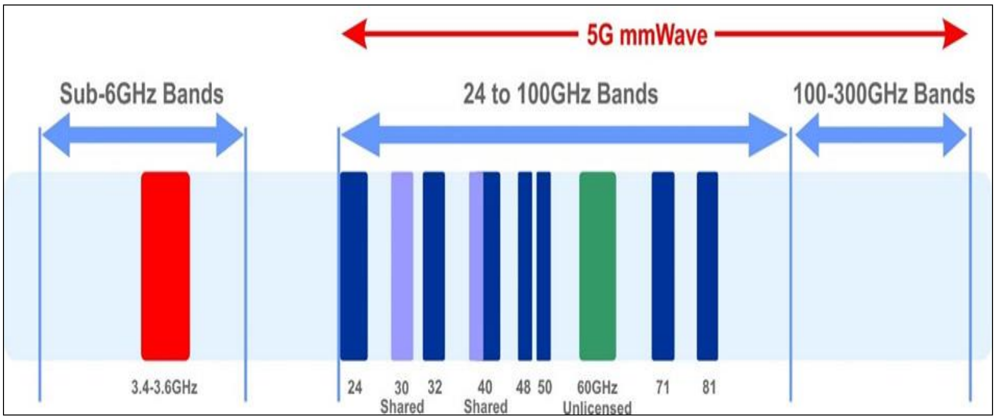

Fig.2 5G mmWave Spectrum

The high-frequency bands above 24 GHz were chosen because they could support large bandwidths and high data rates, which would be perfect for making wireless networks bigger. Due to the short wavelengths that can be measured in millimeters, these high-frequency bands are often called "mmWave." Even though the mmWave bands go all the way up to 300 GHz, 5G will likely only use the bands from 24 GHz to 100 GHz. Without combining bands, mmWave bands up to 100 GHz can support bandwidths of up to 2 GHz. This means that more data can be sent at the same time. When you look at the mmWave bands that are available in the US, you can get a good idea of the spectrum that can be used for 5G networks. The FCC has taken steps toward making more spectrum available for 5G and hinted that more licensed bands will be made available for use.[8]

State-of-the-Art of Approaches -In [10], the authors gave a review of 5G mmWave communications. The benefit of mmWave communications is that they can be changed. This means that the architectures and protocols, which are made up of integrated circuits, systems, etc., can be updated. The authors looked at the current solutions and looked at how well they worked and how well they worked. They also talked about the open research questions for mmWave communications in 5G, such as the software-defined network (SDN) architecture, network state information, efficient regulation techniques, and the heterogeneous system. In [11], the authors talk about the recent work that researchers have done on 5G. They talk about the challenges and needs of designing mmWave 5G antennas for cell phones. After that, they made a 60 GHz array of antenna units that are small and have a low profile. These units have 3D planer mesh-grid antenna elements. For the future, a framework is being made in which antenna components will be used to make mmWave 5G smartphones work with cell phones. Also, they checked the mesh-grid array of antennas against the polarized beam to see if there were any challenges coming up with the hardware.

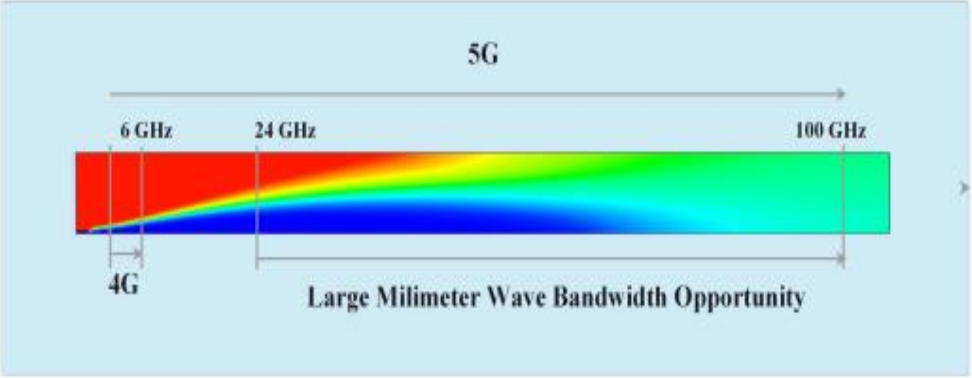

Fig.3. Pictorial representation of millimeter wave.

ISSN : 2455-9679
SJIF Impact Factor : 6.008

In [12], the authors thought about how well the mmWave band would work for 5G cell phone systems. They suggested a system for allocating resources for simultaneous D2D communications in mmWave 5G cellular systems. This system makes the network more efficient and keeps the network connected. This research article can help with simulating D2D communications in mmWave 5G cellular systems. Massive mmWave BS can be set up to get a high rate of delivery and overall efficiency. Because of this, many wireless users can switch between mmWave base stations, and there is a need to find the neighbor with the best network connection. In [13] the authors gave a short description of the crowded cellular spectrum, which is between 1 GHz and 3 GHz. Also, they talked about some important things to keep in mind when setting up mmWave communications in 5G, such as the channel characteristics of mmWave signal attenuation due to free space propagation, gaseous atmosphere, and rain. The mmWave technique's hybrid beamforming architecture is also looked at. They also suggested ways to deal with the way penetration damage blocks mmWave communications. Lastly, the authors have looked into how to design mmWave transmission with small beams that don't interfere with each other. This part talked about different things that have been done with 5G mmWave technology

II. RELATED WORK

Naser Al-Falahy [14] in this work, the distributed base station (DBS) with remote radio head (RRH) is considered as the envisioned architecture of the fifth generation (5G) network. DBS network architecture supports easier scalability for network expansions using remote antennas in the form of RRHs. RRHs have been used in this work in order to compensate for the high path loss and penetration loss that characterise millimetre wave (mmWave) communications. The band of interest is the pioneer band at 26 GHz, which has been recently released for 5G services focused on areas of high traffic demand in the UK. DBS architecture can minimize the number of base stations required for the same quality of service (QoS). An algorithm has been developed for DBS scheduling. In addition to that, the gain of using DBS has been demonstrated in terms of: increasing the user data throughput, decreasing the unnecessary handovers as a result of dense network deployment, increasing the coverage probability in terms of line-of-sight (LoS) coverage, and minimising the impact of shadow fading. The results have shown significant improvement in terms of peak, average, and cell-edge data throughput, and the LoS coverage probability has been improved due to the spatial distribution of RRHs

Sagar Juneja (2022)[15] Multiband antenna implementation is necessary for millimeter wave (mmW) 5G applications to overcome the attenuation losses effects at these high frequencies, and to improve the spatial coverage using spatial multiplexing. In this work, a single layered, planar, end fire, and linear antenna array of four elements has been designed, which is fed by a 4X4 Butler matrix based beam switching circuit to produce spatially distributed beams. This antenna system that is implemented using transmission lines has total dimensions of 58.6 mm X 37.7 mm. Four beams produced using the proposed antenna system are spatially distributed with one beam each in 69°, 84°, 97.5° and 112° directions. Peak gain of 13 dBi, side lobe levels of -7.3 dB, and total efficiency of 95% have been achieved with the proposed design that has a wide impedance bandwidth ranging from 26.5 GHz to 30.5 GHz. These values of radiation parameters make this multibeam antenna ideal for mmW 5G implementation.[55]

Sheng Jie Yang (2022): This letter presents a dual-wideband dual-polarized antenna that fully covers the fifth-generation (5G) millimeter-wave (mm-wave) bands of n257–n261 (24.25–29.5 GHz and 37–43.5 GHz), and that shows a low-profile feature and a band-stop filtering response. For each polarization, the low-band and high-band radiation modes are, respectively, achieved by the two pairs of U-shaped dipole arms which are distributed along the co- and cross-polarized directions. Meanwhile, a radiation null is generated by the radiating cancellation effect of the two pairs of dipole arms, suppressing the unwanted frequency between the two operating bands. Moreover, an extra high-band resonant mode is introduced by the parasitic patches, enhancing the bandwidth of the proposed antenna. Furthermore, a vertical balun structure connecting each dipole arm with the ground is bent to reduce the antenna profile. In the fabrication, high-density interconnect printed circuit board process is employed to meet the antenna-in-package consideration. Under the constrained substrate thickness of 1 mm, the proposed antenna achieves a dual-wideband operation of 24–30 GHz (22%) and 37–43.5 GHz (16%). These merits make the proposed antenna suitable for 5G mm-wave communications.[56]

ISSN : 2455-9679
SJIF Impact Factor : 6.008

NOMA) system-This correspondence examined a new secure beamforming (SBF) scheme for multiple-input single-output non-orthogonal multiple access (MISO-NOMA) system. In particular, the proposed SBF scheme effectively uses artificial noise to protect the confidential information of two legitimate users assisted by NOMA so that only the interceptor's channel is broken. Given the practical assumption of incomplete worst-case continuous interference cancellation, which is a unique feature of using NOMA transmission, we obtain a closed form of interrupt probability confidentiality to characterize confidential performance. Later, we will analyze the diversity of confidentiality to provide more insight into secure MISO-NOMA transmissions. The numerical results show the accuracy of the developed analysis results and the effectiveness of the proposed SBF scheme.

Lu Lu et al. 2018 [17]- a new secure beam beaming (SBF) scheme for multiple input single output non-orthogonal multiple access (MISO-NOMA) system. In particular, the proposed SBF scheme effectively uses artificial noise to protect the confidential information of two legitimate users assisted by NOMA, thereby only impairing the listener's channel. Given the practical assumption of incomplete worst-case continuous interference cancellation, which is a unique feature of using NOMA transmission, we obtain a closed form of interrupt probability confidentiality to characterize confidential performance. Later, we will analyze the diversity of confidentiality to provide more insight into secure MISO-NOMA transmissions. The numerical results show the accuracy of the developed analysis results and the effectiveness of the proposed SBF scheme.

III. PROPOSED SYSTEM

The use of distributed base station architecture can help to improve the coverage and capacity of mmWave 5G networks, making them more reliable and efficient for users. Millimeter wave (mmWave) frequencies are being explored as a key technology for the next-generation 5G cellular networks, due to their potential to offer much higher data rates and greater capacity than current cellular networks. However, mmWave signals have a shorter range and are more prone to attenuation, which limits their coverage and capacity. One approach to address this issue is to use a distributed base station architecture, where multiple base stations are deployed in a given area, rather than a single large base station. This approach has the potential to improve both coverage and capacity of the mmWave 5G network.

In distributed base station architecture, each base station covers a smaller area than a traditional macro base station. This means that the signal strength received by each user will be stronger, as the distance between the user and the base station is reduced. This can lead to a reduction in signal attenuation and an improvement in coverage.

Distributed base station (DBS) architecture is a potential solution to address the coverage and capacity challenges of mmWave 5G networks. In DBS, multiple small cells are distributed in a given area to enhance the coverage and capacity of the network. Initialize the network by setting up the distributed base station with millimeter wave capabilities. Assign each user equipment (UE) to a specific beamforming direction to establish a communication link between the UE and the base station. Configure the system to use Orthogonal Frequency Division Multiplexing (OFDM) as the modulation scheme for the transmission. Implement Non-Orthogonal Multiple Access (NOMA) to allow multiple UEs to share the same frequency band and time slot. One of the key components of a millimeter wave 5G network is the distributed base station, which is a network of smaller base stations that are spread out over a wide area. This allows for better coverage and capacity, as well as reduced latency and interference. In addition, two technologies that are commonly used in millimeter wave 5G networks are Orthogonal Frequency Division Multiplexing (OFDM) and Non-Orthogonal Multiple Access (NOMA).OFDM is a modulation technique that divides a high-speed data stream into multiple subcarriers, which are then transmitted simultaneously. This allows for efficient use of the available bandwidth and reduces the effects of interference.NOMA is a multiple access technique that allows multiple users to share the same time and frequency resources. This is done by assigning different power levels and codes to each user, which allows them to be distinguished from one another. The number of users and mobile devices that can be supported by a millimeter wave 5G network using distributed base stations with OFDM and NOMA will depend on a variety of factors, including the bandwidth available, the number of subcarriers used, the modulation scheme employed, the transmit power of the devices, and the distance between the devices and the base stations.

The usage of a millimeter-wave band with a frequency range of 30–300 GHz is a crucial aspect for boosting the performance of 5G mobile communication networks. Due to the unique propagation properties of millimeter-wave signals, particularly in non-line-of-sight zones, the system architecture and antenna construction for 5G mobile communications must be built to overcome these propagation restrictions. In order to realize 5G mobile communications, the Electronics and Telecommunications Research Institute (ETRI) is constructing a central network utilizing a variety of enormous antenna constructions with beam shaping.

Increased coverage: By deploying more small cells, the coverage area of the network can be expanded, and gaps in coverage can be filled in. This is because small cells can be placed closer to users, reducing the distance that signals need to travel and increasing the likelihood of signal reception.

Improved capacity: With more small cells, the network can support more users and more data traffic simultaneously. This is because small cells operate on different frequencies than traditional macro cells and can reuse the same frequencies in different areas, reducing interference and increasing network capacity.
Better signal quality: By deploying small cells closer to users, the signal quality can be improved. This is because the signal strength decreases rapidly with distance, and by reducing the distance, the signal-to-noise ratio can be improved, leading to better reception and higher data transfer rates.

Enormous Antenna Structure (MAS). For the design and implementation of the enormous antenna structure, antenna miniaturization is required in order to densely integrate a large number of antennas in BS and RBS. Owing to the extremely small wavelength of the millimeter-wave band, the antenna diameters of BS and RBS transceivers can be drastically reduced. Massive numbers of transceivers are densely integrated in a small area of BS and RBS using subminiature antennas.

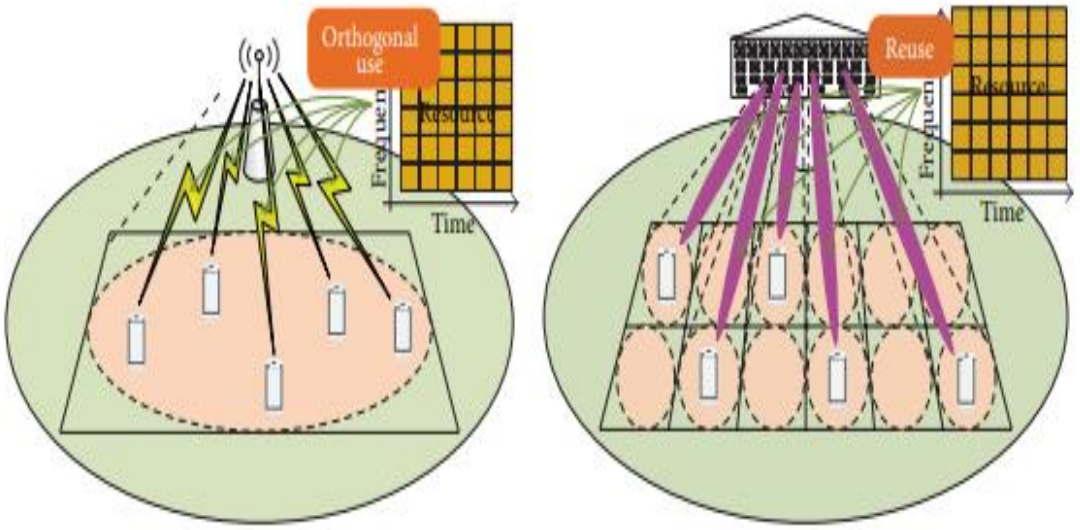

Fig. 4.: Spatial division multiple access by using beamforming and massive antenna structure

Simulation Parameters

- Channel taps number chanTapNo = 10
- Subcarrier length DataLen = 256
- pilot number in each subcarrier No Pilots = 32
- cyclic prefix length CPLen = chanTapNo-1
- Channel impulse response with fade variance fade Impulse = 0.5
- OFDM symbols. ofdmSym = (DataLen-NoPilots
- Frame number frameNo = 10^3
- SNRdB = 20; % SNR value

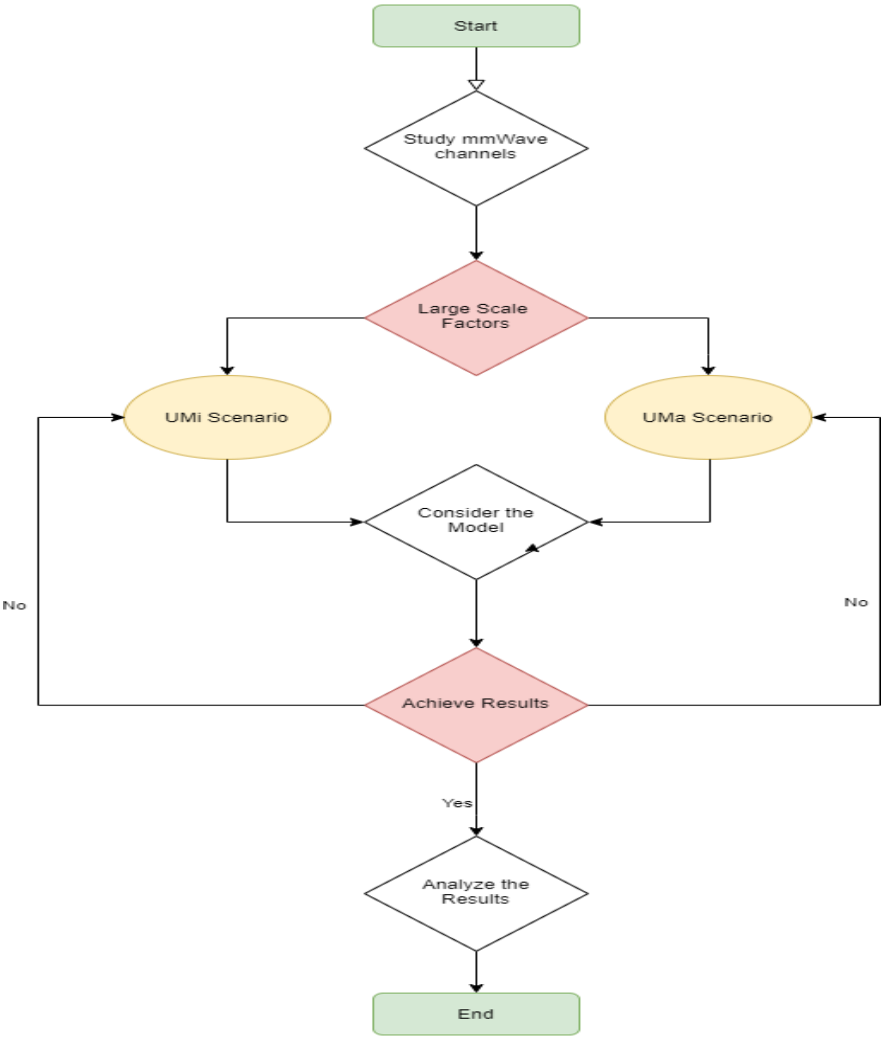

Fig.5 system flow diagram

Coverage and capacity estimation: The coverage and capacity of the DBS-based mmWave 5G network are estimated using mathematical models and simulation techniques.

IV. SIMULATION STEPS

Step 1: Determine the Network Topology

The first step is to determine the network topology, i.e., the arrangement of base stations and their interconnections. A distributed base station topology typically consists of multiple small cells, each covering a small geographical area. These cells are interconnected through a backhaul network, such as fiber or microwave links.

Step 2: Assign Frequencies

Next, we need to assign frequencies to the base stations. Millimeter-wave frequencies (above 24 GHz) are typically used in 5G networks to provide high bandwidth and low latency. However, millimeter-wave signals have high attenuation and are susceptible to blockage by obstacles. Therefore, the base stations should be carefully placed to ensure that they have a clear line of sight to the user equipment.

Step 3: Implement Beamforming

To overcome the attenuation and blockage of millimeter-wave signals, beamforming techniques are used. Beamforming allows the base station to focus the signal in a specific direction towards the user equipment, thereby increasing the signal strength and reducing interference. The algorithm should implement beamforming techniques such as phased array antennas or MIMO (multiple-input multiple-output) systems.

Step 4: Perform Channel Estimation

To optimize the beamforming and improve the signal-to-noise ratio (SNR), channel estimation techniques should be used. Channel estimation involves estimating the characteristics of the wireless channel between the base station and the user equipment. The algorithm should use techniques such as pilot signals or channel state information (CSI) feedback to estimate the channel.

Step 5: Implement Dynamic Spectrum Access

Millimeter-wave frequencies have limited coverage due to their high attenuation and susceptibility to blockage. Therefore, the algorithm should implement dynamic spectrum access techniques to efficiently use the available spectrum. Dynamic spectrum access involves monitoring the spectrum usage and selecting the best available frequency band for transmission.

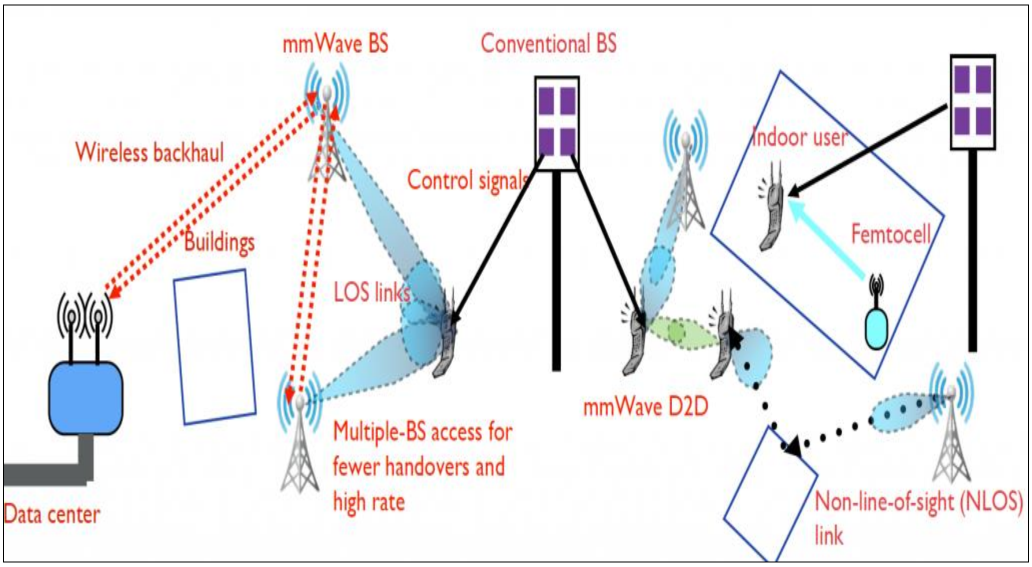

Fig.6 UMi scenario

UMi scenario -Micro channels in 5G refer to the small-scale fading effects that occur due to the interaction of the radio signal with objects in the environment, such as buildings, trees, and vehicles. These effects are highly variable and random, and can have a significant impact on the performance of the 5G network. One approach to studying micro channels in 5G is to use a propagation model that takes into account both the large-scale and small-scale factors that affect the radio signal. The Unified Millimeter Wave (UMi) scenario is a widely used propagation model that describes the propagation characteristics of the 5G mmWave frequency band in urban environments.

The UMi scenario considers both the line-of-sight (LOS) and non-line-of-sight (NLOS) paths between the transmitter and receiver, and models the path loss, shadowing, and small-scale fading effects using statistical models. The small-scale fading effects are typically modeled using the Rayleigh or Rician distribution, which describe the random variations in the signal strength due to multipath propagation.

In addition to the UMi scenario, there are other propagation models that can be used to study micro channels in 5G, such as the Extended Urban Macrocell (EUMa) scenario and the Indoor Office (InH) scenario. These models take into account the specific characteristics of different environments and can provide more accurate predictions of the radio signal behavior in those environments. The frequency and bandwidth of the radio signal, and the resource allocation and scheduling algorithms. These simulations can help to optimize the network design and resource allocation to improve the network performance and reliability in the presence of

4.3 SIMULATION RESULTS

DBS architecture in the radio access network (RAN), cellular network is modelled with a BS that is responsible for providing coverage and resources assignment to the users. The default architecture is three sectors implementation, in which the BS is transmitting with directional antennas in three directions. All antennas are co-located at the BS location, the term CBS will be used for future representation of ‘Co-located BS’ architecture. An alternative approach is the DBS network architecture. DBS splits the BS into two parts: the BBU part located at the centre and RRHs part that are mounted on remote towers apart from their own BBUs. In this scheme, the RRHs are connected with a high-speed fiber link to the BBUs. Fibre links are used to power the RRHs as well as to carry the signaling.

The DBS architecture is similar to the classical C-RAN architecture, but in this work, the RRHs are used to overcome the high path loss and penetration loss that characterize mmWave propagation [9, 18, 21]. The DBS network fits well with C-RAN network architecture. In C-RAN, BS comprises a number of distributed RRHs that are connected with high-speed fibre links to their BBUs, where all data processing is handled. Signalling is carried over dedicated links called fronthaul, which connect the RRHs to the BBU [22]. RRHs have the ability to improve the signal-to-interference plus noise ratio (SINR) in their deployment area.

DBS architecture representing three co-located BBUs, and for each BBU there are two distributed RRHs, on left the path loss map is shown, while in right the path loss and shadow fading map are shown. As shown in this figure, SINR is improved in the regions of RRHs deployment. The RRH system design includes transceivers, duplexers, analogue-to-digital conversion (ADC), filtering processes, and power amplifier (PA) stage. DBS network architecture paves a new paradigm for 5G UDN deployment, by making the next generation network architecture efficient, flexible, and scalable.

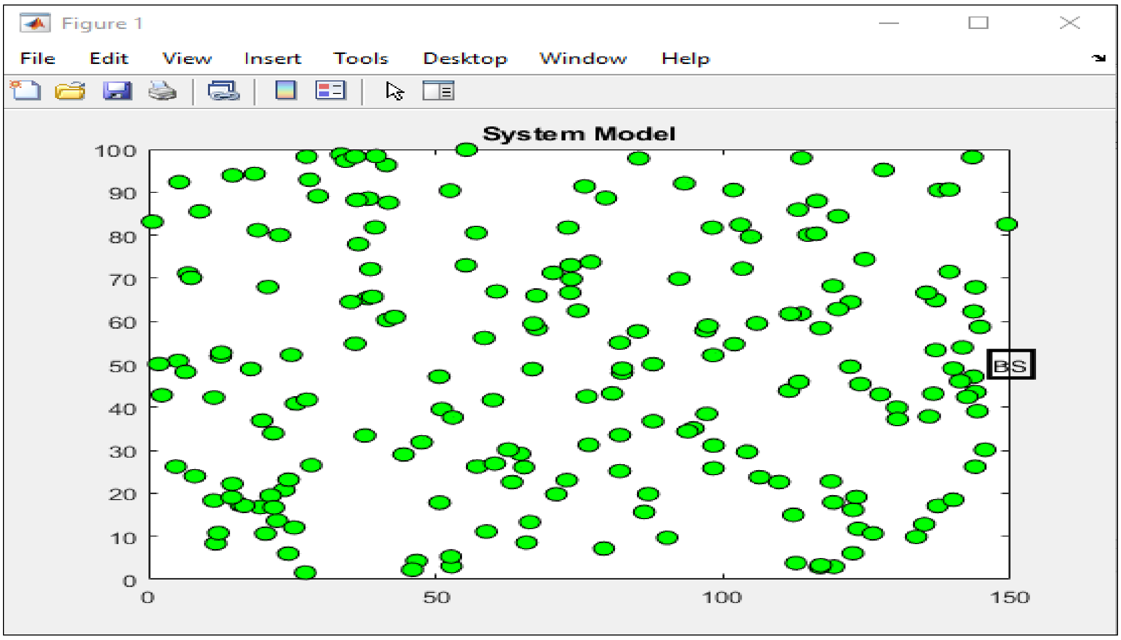

Fig.7 System model

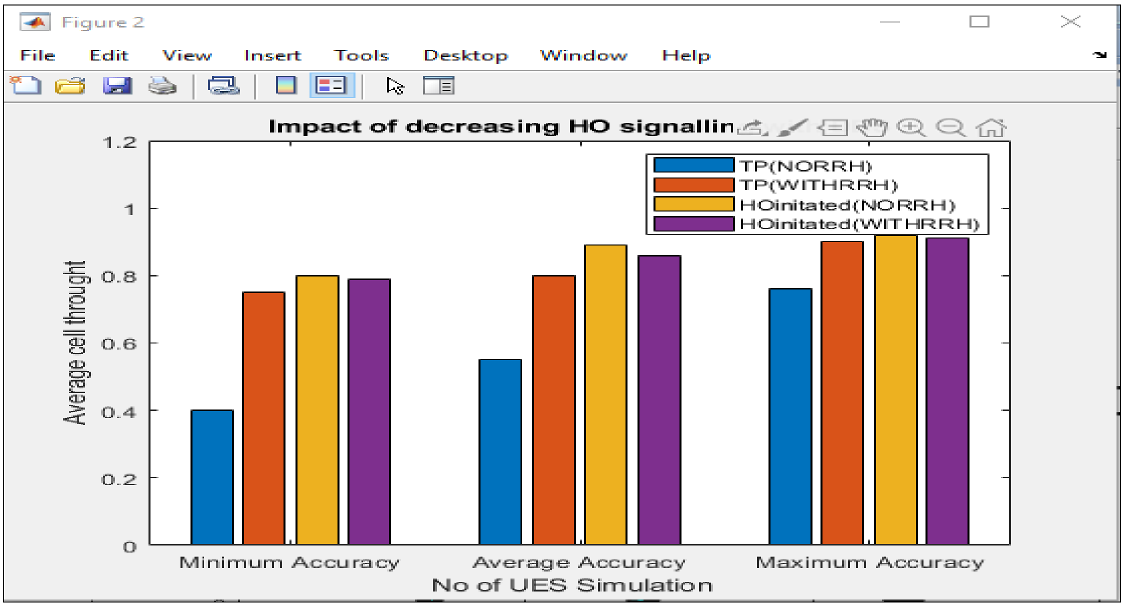

Fig.9 impact of decreasing HO signaling

In the case of high mobility, handovers between close cells will raise the signaling overhead, degrading network performance. In DBS architecture, however, RRHs will avoid unwanted handovers because they are transparent to the user equipment, which only sees the central unit where signal processing and scheduling occur. This will drastically reduce the extra signaling caused by handoffs, hence increasing the cell's capacity.

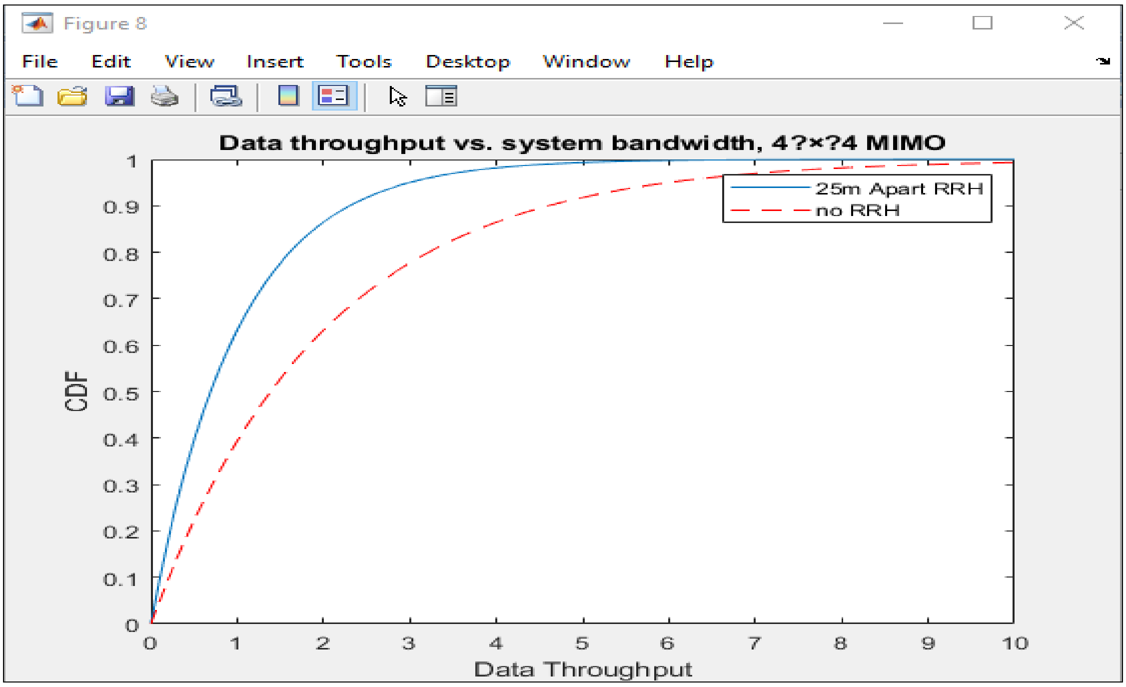

Fig.10 data throughput and system bandwidth

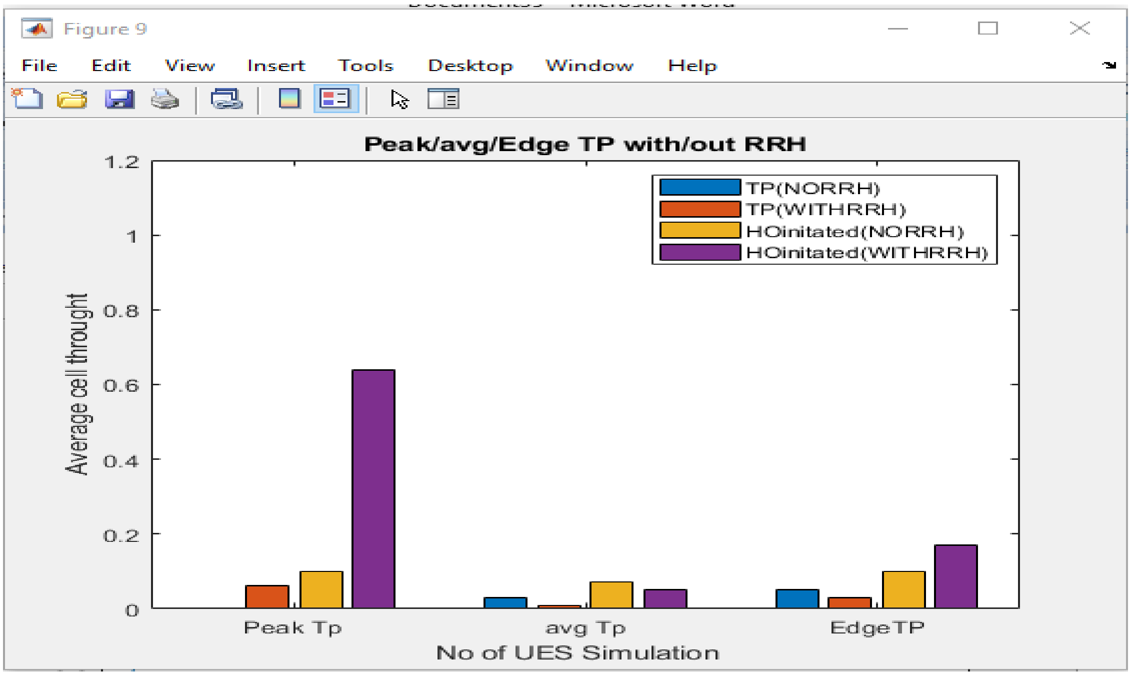

Fig.11 average throughput

Figure 14 illustrates how the utilization of RRHs affects the handover process. The reason for the low number of handovers in DBS architecture is that when UE move according to the walking model and pass into RRH with a stronger SINR, a handover will not be triggered. This results in a low number of handovers. Whereas in the case of CBS, a handover takes place whenever the user equipment (UE) moves into a cell with a higher SINR. The excessive handovers result in an increase in the amount of signaling overhead, which in turn results in a reduction in the performance metric known as the data throughput. Because of the increased likelihood of handovers in such a congested environment, the DBS design provides greater performance in the UDN scheme compared to the CBS architecture.

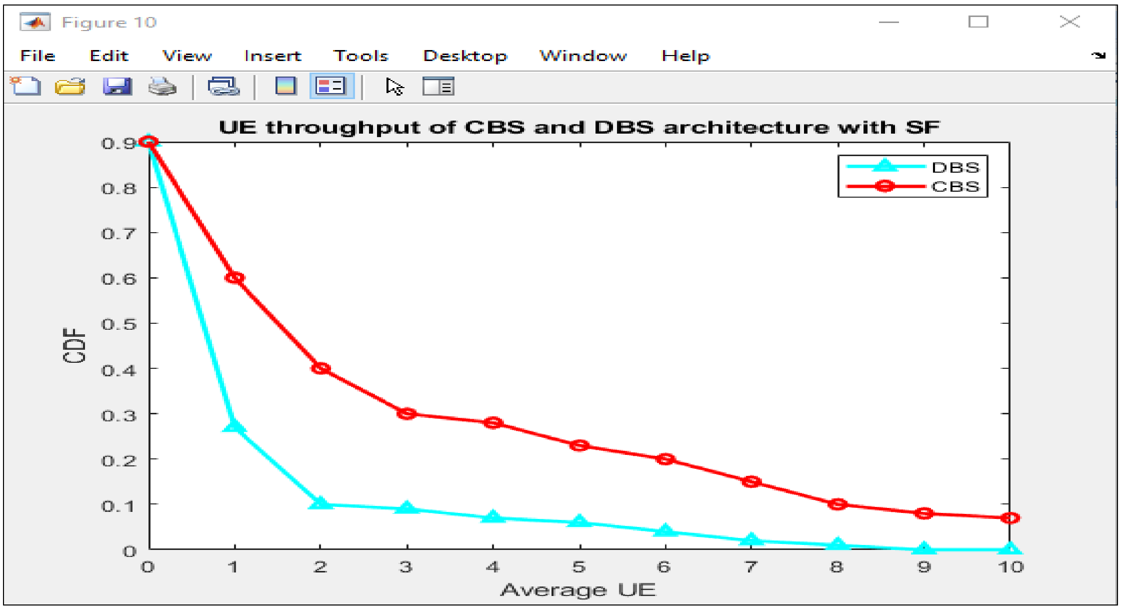

Fig.12 CBS and DBS architecture

The results of this simulation show that DBS networks have an advantage over CBS networks in a variety of scheduling techniques, both in terms of the amount of data that can be transferred and how fairly it is distributed. The simulation of the scheduling process has been carried out for the RR, PF, and best CQI algorithms. Seven BSs have been taken into consideration, with ten UEs allocated to each BBU. As can be seen in Figure 15, the peak, average, and cell edge data throughputs have been demonstrated for both the DBS and CBS architectural configurations.

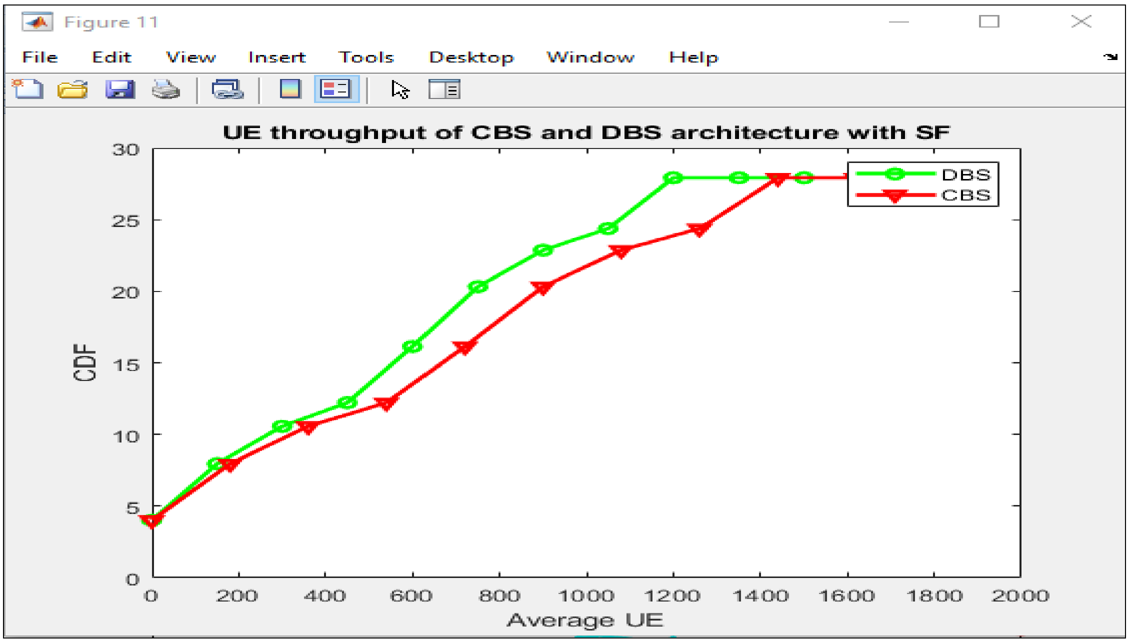

Fig.13 UE throughput of CBS and DBS architecture

In wireless communication systems, the CBS and Distributed Base Station architectures both have the potential to produce high throughput; however, whether or not they are suitable depends on the particular requirements of the system. SF is a method that can be implemented with either architecture to improve data throughput by utilizing the

ISSN : 2455-9679
SJIF Impact Factor : 6.008

spatial dimension of the communication channel. This can be done by leveraging the spatial dimension of the channel. The performance of the DBS architecture is superior to that of the CBS architecture, where distributed RRHs help to prevent shadow fading in the network.

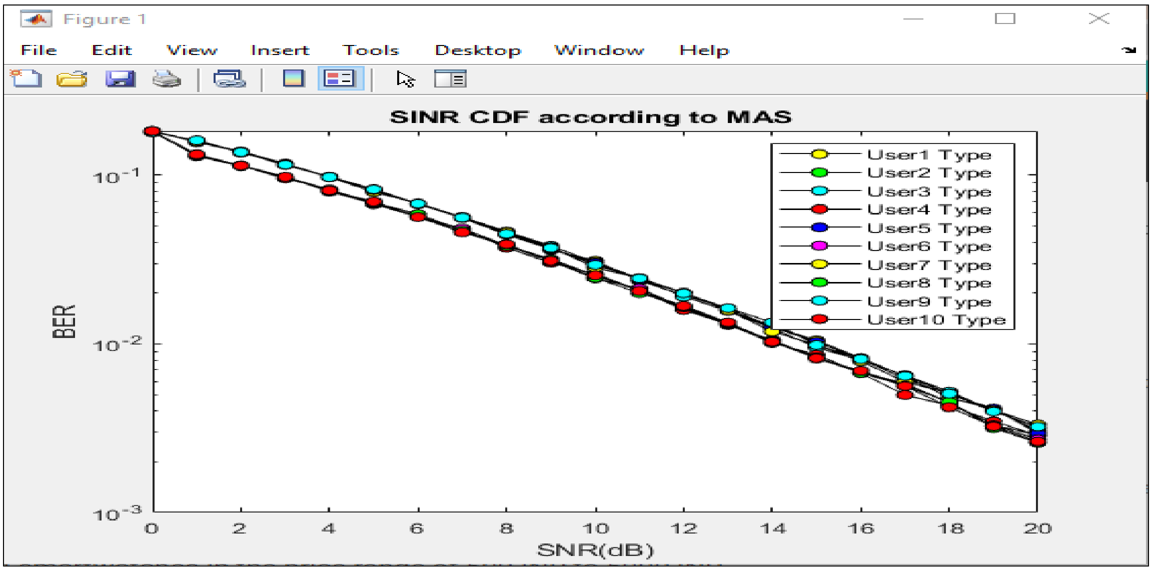

Fig.14 SNR Vs.BER performance

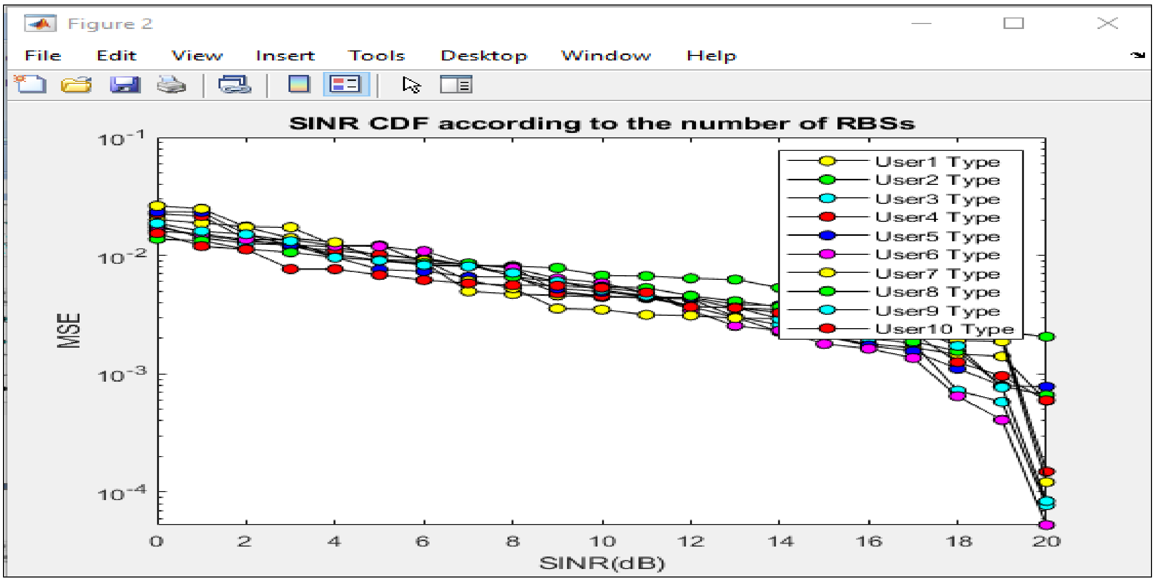

Fig.15 variation of the system capacity according to the number of RBSs

The variance in system capacity that can be seen in Figure 15 is displayed as a function of the number of RBSs. Because MAS and beamforming have been implemented in the central network, radio resources can be reused in space, and the system capacity can expand in proportion to the number of mobile devices. However, introducing new RBSs into an already established network may result in interference with the functioning of the existing BS and RBS. So, in order to reduce the amount of interference that occurs as a result of this, new RBSs need to be installed in areas that do not overlap the coverage area of existing BS and RBS. It is possible to improve the performance of mobile devices on coverage holes by paying attention to the interference between base stations (BS) and radio base stations (RBS) when deploying new RBS. Figure 4.18 is a CDF representation of the data rates that can be achieved by each mobile device with a range of different numbers of RBSs.

ISSN : 2455-9679
SJIF Impact Factor : 6.008

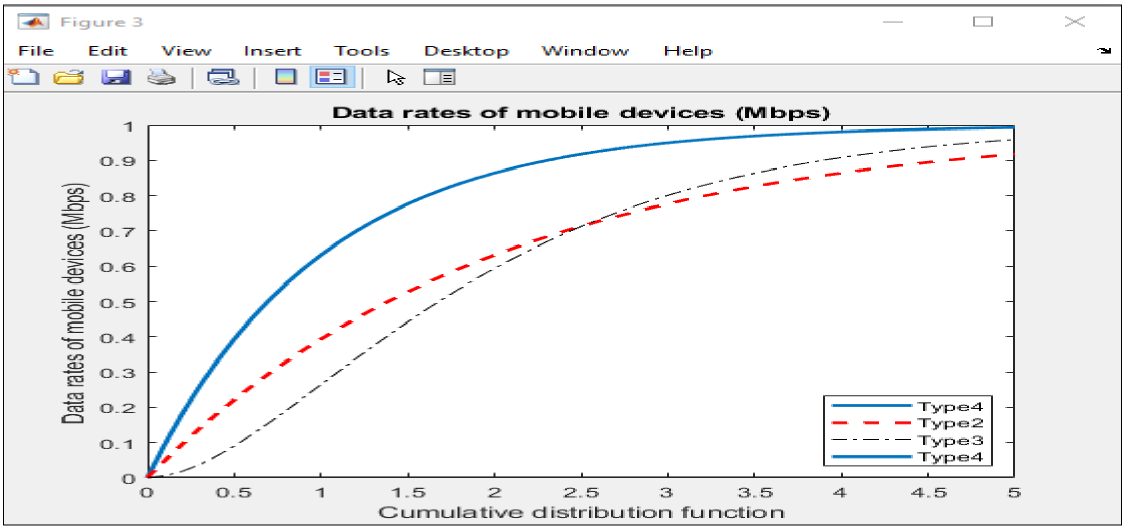

Fig.16 data rates of number of device

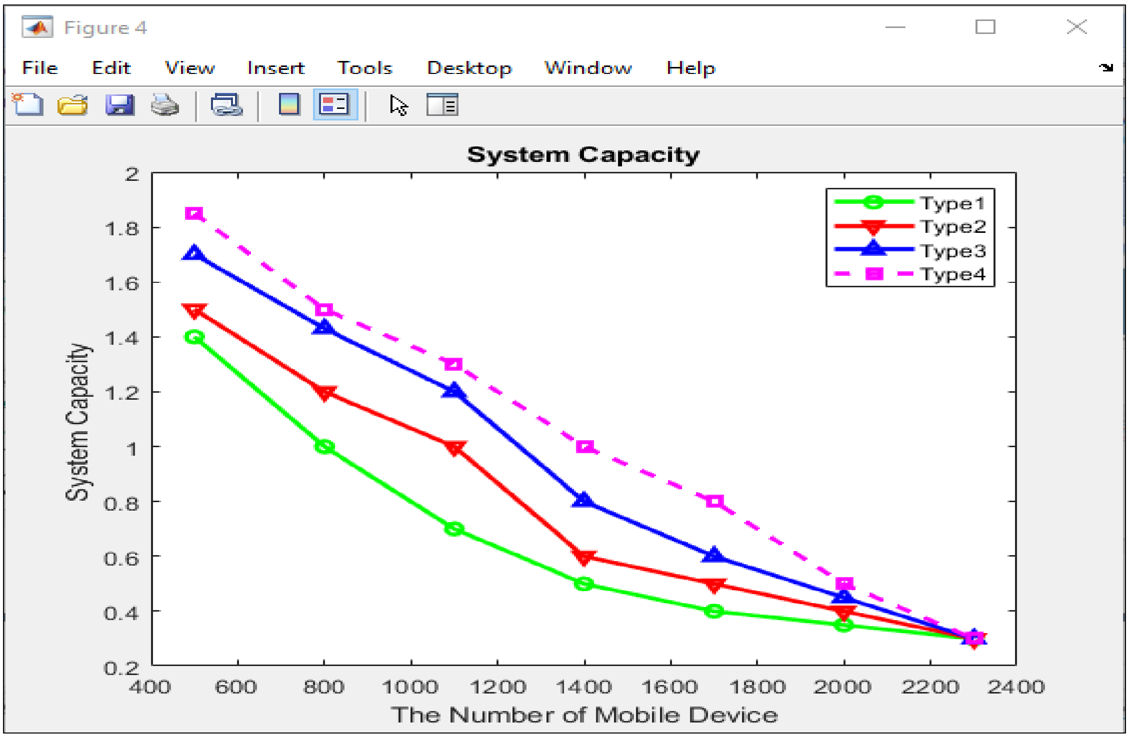

Fig.17 system capacity for number of mobile device

Because MAS directly affect both the amount of transmitted signal power obtained by antenna gain and the amount of interference power that occurs between nearby beams, MAS is a critical component in the process of increasing the capacity of the central network.

V. CONCLUSION

In this work, a DBS network architecture in mmWave is proposed to reduce propagation losses by putting RRHs in different places instead of putting all antennas at the central node, as is done in CBS architecture. The simulation has shown that spatially distributed RRHs can boost signal strength in the areas where they are used and make up for the high path loss that is typical of mmWave propagation. So, the network's peak, average, and data throughput at the edge of a cell have all gotten better. Also, DBS architecture can reduce the number of handovers that aren't needed in a dense network. These handovers put a strain on the wireless network because they require more signaling. The millimeter-wave band between 30 and 300 GHz is a top choice for a new radio band that can make the central network for 5G mobile communications much more powerful. But because millimeter waves don't travel well, the central network thought about MAS with beamforming, which would let them send and receive more data. In this paper, we used system-level simulation to measure the central network's system coverage and capacity based on how MAS is set up. Simulations showed that the way the antennas are set up, such as their arrangement, tilt angle, and distance from each other, has a strong effect on the system's coverage and capacity. In general, an antenna that sends out a wide beam can make the system's coverage area bigger, while an antenna that sends out a narrow beam can improve channel quality and system capacity by reducing interference between beams. So, for a high-performance 5G mobile communication system, it is important to find the best beam pattern and configuration for the antenna structure, which is made up of base stations and relay base stations. We hope that our research can be used to help design the architecture and structure of 5G systems.

In the future, it would be a good idea to test and use wave propagation models in real life to figure out the path loss. This would be good for work and development, since the mathematical models of those models could be changed. You can also find unlicensed frequency spectrum above 60 GHz, which is a promising area of work and useful for high data rate applications indoors and outdoors. Another possible area of research for future work is using machine learning techniques to predict and improve wave propagation models.

REFERENCES

[1] US Cellular, Qualcomm, Ericsson, and Inseego Address Digital Divide with Multi-Gigabit Extended-Range 5G Milestone Over mmWave, https://www.ericsson.com/en/press-releases/6/2021/5/uscellular-qualcomm-ericsson- and-inseego-address-digital-divide-with-multi-gigabit-extended-range-5g-milestone-over-mmwave
[2] Sidharth Mohanty; Arun Agarwal; Kabita Agarwal; Sabita Mali; Gourav Misra Role of Millimeter Wave for Future 5G Mobile Networks: Its Potential, Prospects and Challenges 2021 1st Odisha International Conference on Electrical Power Engineering, Communication and Computing Technology(ODICON) Year: 2021 | Conference Paper | Publisher: IEEE
[3] Jia Wang Li; Lei Xiang; Yun Hu; Wei Hong Dual polarized Antenna and Array with Filtering Response and Low Cross Polarization for 5G Millimeter Wave Applications 2021 13th Global Symposium on Millimeter-Waves & Terahertz (GSMM) Year: 2021 | Conference Paper | Publisher: IEEE.
[4] Wei-Ning Ying; Tao Xu; Yu Lu; Guo-Qiang He; Xue-Xia Yang A Broadband Linear to Circular Polarization Converter for 5G Millimeter Wave Communication 2021 International Conference on Microwave and Millimeter Wave Technology (ICMMT) Year: 2021 | Conference Paper | Publisher: IEEE
[5] Kasfia Zaman Md Munjure Mowla A Millimeter Wave Fronthauling Solution for Open RAN Paradigm in 5G and Beyond Networks 2021 IEEE International Conference on Telecommunications and Photonics (ICTP) Year: 2021 | Conference Paper | Publisher: IEEE
[6] Abdul Qahar; Kartinah Zen; Muhammad Anwar; Awais Khan Energy Efficient Millimeter Wave Backhauling in 5G Heterogeneous Networks 2021 International Conference on Innovative Computing (ICIC) Year: 2021 | Conference Paper | Publisher: IEEE
[7] 3GPP TS 38.106. NR Repeater Radio Transmission and Reception
[8] 3GPP TR 38.867 Study on NR Network-controlled Repeaters - https://www.gsma.com/futurenetworks/resources/5g-mmwave-deployment-best-practices-whitepaper/
[9] W. Lehr, F. Queder, and J. Haucap, 5G : A new future for Mobile Network Operators , or not ?,‖Telecomm. Policy, vol. 45, no. 3, p. 102086, 2021.
[10] M. Series, Guidelines for evaluation of radio interface technologies for IMT-2020,‖ vol. 0, 2020
[11] S. A. Id, U. Qamar, and R. N. Id, HCF-CRS : A Hybrid Content based Fuzzy Conformal Recommender System for providing recommendations with confidence,‖ pp. 1–30, 2018.
[12] Ming Zeng, Nam-Phong Nguyen, Octavia A. Dobre, and H. Vincent Poor Downlink MIMO-NOMA Networks with Artificial Noise DOI 10.1109/JSTSP.2019.2901170, IEEE 1932-45 53 (c) 2018 IEEE.
[13] Beixiong Zheng, Miaowen Wen, Member, Cheng-Xiang Wang Xiaodong Wang, Fangjiong Chen, Member, Jie Tang, Member, , and Fei Ji, Member, Secure NOMA Based Two-Way Relay Networks Using Artificial Noise and Full Duplex IEEE JOURNAL 0733-8716 (c) 2018 IEEE.
[14] Naser Al-Falahy1,2 , Omar Alani1 Coverage and capacity improvement of millimetre wave 5G network using distributed base station architecture ISSN 2047-4954 Received on 10th May 2018 Revised 13th December

2018 Accepted on 4th February 2019 E-First on 25th February 2019 doi: 10.1049/iet-net.2018.5059 www.ietdl.org IET Netw., 2019, Vol. 8 Iss. 4, pp. 246-255

[15] Sagar Juneja; Rajendra Pratap; Rajnish Sharma Planar Endfire Multibeam Antenna Implementation for Millimeter Wave 5G Applications using a Passive Beam Switching Network 2022 IEEE 2nd Mysore Sub Section International Conference (MysuruCon) Year: 2022 | Conference Paper | Publisher: IEEE

[16] Sheng Jie Yang; Shu Feng Yao; Ru-Yu Ma; Xiu Yin Zhang Low-Profile Dual-Wideband Dual-Polarized Antenna for 5G Millimeter-Wave Communications IEEE Antennas and Wireless Propagation Letters Year: 2022 | Volume: 21, Issue: 12 | Journal Article | Publisher: IEEE

[17] Lv, Student Member, , Zhiguo Ding, Qiang Ni, Secure MISO-NOMA Transmission With Artificial Noise and Jian Che n, Member, IEEE 00189545 (c) 2018 IEEE.