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ANALYSIS OF 5G MOBILE COMMUNICATION MIMO SYSTEM WITH OFDM

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Abstract – In today's modern era the speed of mobile communication system plays an important role in human's life. As numbers of customers are rapidly increases, there is necessity of improvement in speed of the network with as low as delay. Starting from first generation mobile communication speed makes the difference and researchers attracts to improve the speed of the network. When 3G and 4G are not fulfilling the gap of speed in human and their use then it is important to design 5G mobile communication system. 5G is planning to target at higher capacity than current 4G system, with higher density of mobile broadband customers. In this paper the design of 802.11 based 5G mobile communication systems with MIMO (Multiple Input Multiple Output) and OFDM (Orthogonal Frequency Division Multiplexing) techniques are explained. In this work AODV i.e. Adhoc on demand distance vector routing protocol which is reactive routing protocol is used. Here AODV technique is used to achieve higher throughput and high gain The network is evaluated on the basis of throughput, delay and packet delivery ratio of designed mobile communication system. Here Network Simulator 2 is used to design this proposed system.

Keywords – 5G, mobile communication, MIMO, OFDM, AODV

I.INTRODUCTION

Mobile communication permits the broadcast of voice and multimedia data via a computer or a mobile scheme deprived of having associated to any physical or fixed link. Mobile communication is emerging day by day and has become a must have for everybody. Mobile communication is the altercation of voice and data using a communication substructure at the same time irrespective of any physical link. 5G is the Fifth Generation technology. It has numerous superior quality potential

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sufficient to resolve several of the troubles of our ordinary life. 5th Generation Mobile Network is the approaching rebellion of mobile technology. The quality and its uses are much further than the expectations probability of a regular human being. With its very high speed, it is probable sufficient to modify the meaning of a cell phone uses. With an enormous collection of inventive features, now your smart phone would be more similar to the laptop. One can make use of broadband internet connection other major features that attract people are more gaming options, wider multimedia options, connectivity all over, quicker reply time, and high excellence sound and HD video can be transferred on other cell phone lacking compromising with the superiority of audio and video. In 5G data rates is in Mbps for thousands of users. Data rate up to 100 Mbps for urban area. Spectral efficiency higher than 4G mobile communication system. To achieve this performance, severe improvements require being prepared in cellular network architecture. With boost in the demand of the customers, 4G will now be simply exchanged with 5G with an superior access tools named Beam Division Multiple Access (BDMA) and Non and quasi orthogonal or Filter Bank multi carrier (FBMC) multiple access. [1]. Figure 1 shown the various features of 5G technology. In 5G, 100 times more devices can be connected with faster response time i.e. low delay. In this mobile communication system more software options are available for update. There is wide range of applications in 5G mobile communication system. The architecture of 5G technology is given in figure 2 which consist of variety of servers. The capacity of the 5G mobile communication system is better as compare to existing 4G mobile communication systems.

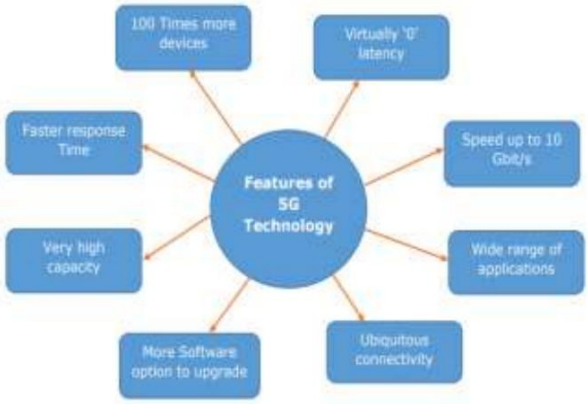

Fig. 1. Features of 5G technology

5G technology can handle all the services provided by GPRS, 3G, WLAN and long term evaluation standards. To achieve these services in fast manner several servers are used like streaming server, data server, real time communication server and

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control system policy server. The functions of these servers are to provide significant information to the cluster. The 5G mobile communication system is having high capacity of throughput than GPRS, 3G, WLAN and LTE standards. The ability of any wireless communication depends on spectral efficiency and bandwidth [2]. The most important technologies for 5G technologies are 802.11 Wireless Local Area Networks and 802.16 Wireless Metropolitan Area Networks, Adhoc Wireless Personal Area Network and Wireless networks for digital communication [3]. Based on the enormous MIMO antennas and the mm wave communication technologies, the 5G ultra populated cellular network is projected to establish in largely cellular scenarios [4].

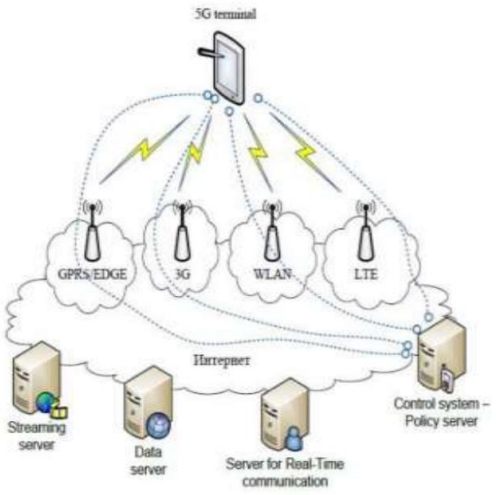

Fig. 2. Architecture of 5G Network

Cooperative relaying techniques are gifted solutions to achieve advanced throughput, better consistency and comprehensive coverage in MIMO communication systems. MIMO represents multiple antennas are connected to transmitter and receiver sides [5]. Large scale antenna system also called as massive MIMO works on time division duplex system. Additional antennas assist by focusing energy into yet smaller regions of space to carry enormous enhancements in throughput and energy efficiency [6], [13]. Orthogonal frequency division multiplexing (OFDM) has turn into a trendy system for transmission of signals over wireless channels. OFDM has been adopted in several wireless standards [7]. Wi-Fi, LTE and many other radio, wireless and RF technologies are with the fresh MIMO wireless technology to offer enlarged link capacity and spectral efficiency collective with enhanced link dependability by what were before seen as interference paths. The standard of diversity is to offer the receiver with numerous versions of the identical signal. If these can be completed to be exaggerated in unlike ways by the signal pathway, the chance that they will all be pretentious at the similar time is

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significantly reduced. Therefore, diversity helps to become stable a link and improves performance, reducing error rate. For coherent detection, channel estimation is necessary for receiver section design. Channel estimation is also needed for diversity combining or interference restraints where there are numerous receive antennas [8]. OFDM transfers the processing load from the frequency domain to the time domain [9]. In this work we are using AODV routing protocol. AODV requires a new path detection process at any time a link breaks, such common road discoveries invite a high routing overhead and boost up delay [10], [11], [12]. Routers gather information about network topology by distributing information between nearby neighbours [14], [15]. OFDM makes effectual use of the band by allowing overlay. Also delivers good defence against co-channel interference and unwary parasitic noise.

II. LITERATURE SURVEY

Massive MIMO is being enthusiastically hailed as a critical technique for next generation of wireless communication networks applications such as 5G & 6G. mMIMO is equipped with a large number of antennae at the base station to serve the end-users. mMIMO boasts of improved spectral efficiency and high communication reliability [15,26]. Amongst features, the ability of OFDM systems to comprehensively interoperate with various modulation techniques makes it the first choice for massive MIMO systems [27]. In the current scenario, massive MIMO systems use OFDM primarily to overcome effects of flat fading channel and multipath propagation [28,29]. Owing to its robust character and backed by powerful technologies such as OFDM, massive MIMO is bound to be the most sought-after technology for next-generation multi-media data transfer requirements. Analysis of available literature reveals various previous works that have investigated image transmission over OFDM communication systems. For instance, authors in [30] evaluated the bit error ratio (BER) performance of different signal mapping techniques (i.e., QPSK, 16-PSK, and 16-QAM) for an OFDM-based image transmission system over the AWGN channel. Similarly, authors in [25] analyzed the BER performance for another set of signal mapping schemes (i.e., BPSK, QPSK, 16-PSK, and 256-PSK). In [31], authors have implemented an OFDM-

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based image transmission system on software-defined radios (SDR) and compared the BER performance in the case of different signal mapping schemes (i.e, BPSK, QPSK, 16-PSK, and 256-PSK). Further, authors in [32] compared image transmission with audio and text transmission using BER and mean-square error (MSE) as comparison metrics. In the same context, the BER of different signal mapping schemes in an OFDM-based image transmission system are compared in the Rayleigh and Rician fading channels in [33,34], respectively. Furthermore, OFDM based image transmission system for an underwater communication channel has been investigated and proposed in [35]. A comparison between FFT-OFDM and DWT-OFDM-based image transmission systems has been presented in [36]. The impact of channel estimation effect on image transmission using OFDM systems has been explained in [37]. The effect of the different channel equalizer types on multi-carrier code-division multiple access (MC-CDMA) based image transmission system was investigated in [38]. It may be further noted here that MC-CDMA is just another version of OFDM in which complex symbols spread throughout all subcarriers in the frequency domain before undergoing IFFT. Another set of research works has been concerned with managing and reducing a chronic issue in OFDM systems: the Peak to Average Power Ratio (PAPR). For instance, the BER assessment of OFDM based image transmission system after using the companding technique for PAPR reduction has been elaborated in [39,40]. Similarly, [41] evaluated the effect tone reservation (TR) technique for PAPR reduction on the BER assessment of OFDMbased image transmission systems. The effect of reducing the PAPR by using discrete cosine transform (DCT) and DFT precoding techniques on the BER assessment of MCCDMA-based image transmission system was studied in [42]. In [43], the authors studied the effect of PAPR reduction in visible light communication (VLC) on the BER assessment of OFDM-based image transmission system. The effect of different decoding algorithms on the BER assessment of MIMO-OFDM-based image transmission system has been proposed in [44,45]. The authors of [3] studied the impact of using combining techniques along with diversity order on the BER of different modulation schemes used for image transmission in MIMO-OFDM

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systems. In [46,47], the authors studied the effect of PAPR reduction on BER, MSE, and PSNR of MIMO-OFDM based image transmission system. Finally, the authors of [48] compared FFT and DCT based MIMO-OFDM image communication systems from SSIM, PSNR, and BER points of view. Pros and cons of previous works have been compared in Table 1. In contrast to the previous works, this work combines mMIMO with OFDM and examines the prposed system performance using pictorial demonstration in addition to PSNR and SSIM. Furthermore, this work investigate the effect of modulation order, number of users, and OFDM transformer type on the performance of the proposed system.

III.PROPOSED SYSTEM

The design of Wi-Fi based 5G mobile communication system is really a challenging task. The basic 5G communication system is given in the figure 3. The function of antennas is to transmit and receive the electromagnetic signals. Here relay plays an important role to transmit the signals for long distance communication. Network infrastructure section consists of processing, switching and storing blocks which is the main heart of communication system. Recently many researchers are working on various algorithms of processing the packets and switching of packets from one circuit to another in rapid fast manner. Here in 5G mobile communication system device to device communication takes place without any intermediate device. Also in 5G integrated networks take place to provide more services to all types of networks.

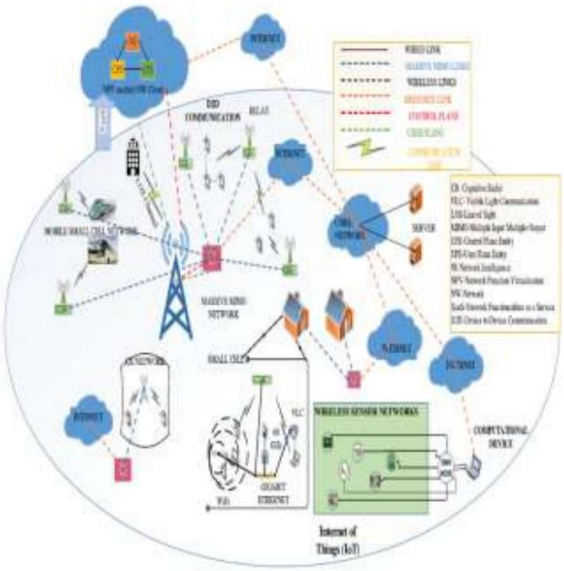

Fig. 3. 5G Communication system

MIMO operation uses numerous antennas that are positioned at equally the source transmitter and receiver. Those antennas are related in order to reduce error and enlarge efficiency of a network. This method's capability to increase the capability of the antenna links has made it necessary part of wireless standards including 802.11n, 802.11ac, HSPA+,

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WiMAX and LTE. The Massive MIMO scheme uses collection of antenna containing little hundreds of antennas which are at the similar time in one time, frequency slot giving lots of tens of customer terminals. The major purpose of massive MIMO technology is to take out all the reimbursement of MIMO but on a well-built level. This model is designed in NS2 software the design steps are stated in figure 4.

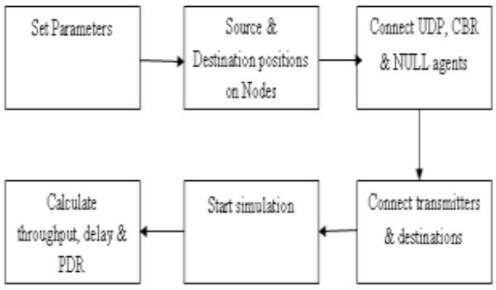

Fig. 4. Design steps of 5G Network

To design Wi-Fi based 5G mobile communication system most important thing is to set the suitable parameters like type of frequency, power, channels, etc. The telecoms business is at present in the procedure of designing the technologies that are due to take over from 4G, which is still being deployed nowadays. An enormous transaction of work is thus in progress to get ready these 5G technologies. The thought that is starting to take form following the idea of 5G is that it will not denote just a boost in broadcast speeds, as has been the case with preceding generations. Device to device is a straight form of communication among two closes by devices, which does not need the data to journey above the cellular network. Device to device communication is not new, as technologies such as Bluetooth and Wi-Fi direct previously facilitate it. In this network there are many mobile nodes which move from one position to another by some speed. So it is essential to set source and destination positions of the nodes. Here we are going to transfer packets from source to destination by UDP agent with CBR. To terminate the data at the destination node we connect NULL agent to the receiver side. Then connect transmitter and receiver to each other. Here we are going to design 5G mobile communication system by using MIMO and OFDM techniques. These two techniques are used to improve the performance parameters of the network and it reduces the interference. Here MIMO represents multiple input and multiple outputs antennas connected to transmitter and receiver sides. Because of the multiple antennas multiples channels will be formed and maximum amount of data can be transmitted at a time within the simulated time period. OFDM is the

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multiplexing technique which reduces the interference. Finally start the simulation and then trace and NAM files will generate which are useful for calculation of throughput, delay and packet delivery ratio.

IV.RESULTS

5G just stands for fifth generation and refers to the subsequently and latest mobile wireless model based on the IEEE 802.11ac standard of broadband technique. Even though a official standard for 5G is yet to be set. For any network simulation parameters are important part. Simulation parameters represent the type and quality of the network. If we change the simulation parameters the performance of the network will suddenly change. Table 1 shows the simulation parameters of the proposed 5G mobile communication system.

TABLE 1. Simulation parameters

Parameters	Value
Frequency	5 GHz
Bandwidth	20 MHz
Channel	Wireless Channel
Propagation model	Two Ray Ground
Mac	802.11 ac
Antenna	Omni directional antenna
Modulation	OFDM
Antenna Connection	MIMO
Queue length	40
No. of nodes	40
Routing protocol	AODV
Packet size	Variable

The frequency band of 5 GHz and 20 MHz bandwidth is used for the design of this mobile communication network. Proposed system is Wi-Fi based 5G mobile communication system hence we used wireless channel. Two ray propagation models are used to achieve more spectral efficiency. Mac type is 802.11 ac to provide ultra high speed to the network. Here we used Omni directional antenna to transmit and receive electromagnetic signals because Omni directional antenna can transmit same signals in all directional in equal magnitude. Here OFDM modulation scheme is used which divides a high data rate modulating packets keeping them onto lot of slowly modulated narrow band close spaced subcarriers and hence it is less sensitive to frequency selective fading. Here MIMO are used to multiply the capacity of the radio path using multiple antennas at transmitter and receiver sides to develop multipath propagation. Queue length is 40, it means that after receiving of first packet destination side will take some time for processing and at that time if second packet get received then that second packet will be in the queue. By this manner maximum 40 packets can be in this queue. Total numbers of nodes are 40 which

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represent 40 mobile nodes. AODV routing protocol is used to decide the suitable route to transfer the packets. Other than above simulation parameters there are some more parameters also which are responsible to provide more better results as compared to existing mobile communication system like bandwidth, data rate, modulation type, etc. The packet size is variable because each and every mobile node cannot transmit same data of same size at a time. So each mobile user has freedom to transmit any data of any size. Variable packet size shows that packet data is adaptive.

The current design is Wi-Fi based 5G mobile communication system with AODV routing protocol. Figure 5 and 6 shows that total 40 mobile nodes which are changing their positions from source position to destination position. Each node is labelled as Mobile Station (MS). The data transmission is also takes place within its transmission and reception coverage range. After completion of this work few Mbps of throughput with delay in msec time period with higher and higher packet delivery ratio will get at the output. Here packet delivery ratio means percentage of packets received at the receiver.

Fig. 5. Snapshot of 5G Mobile communication system

In mobile communication system mobile nodes move from one cluster to another. In this case one mobile leave their particular cluster, if coverage of the netwotk is unavailable then signals or packet may get drop.

Fig. 6. Data transmission in the network

After applying MIMO and OFDM techniques the throughput and packet delivery ratio of the designed system will get gradually increase. The difference in between figure 5 and 6 is that the node

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positions are different. By using MIMO and OFDM the performance parameters will improve and will provide satisfactory results.

V. CONCLUSION

The conclusion of this work is that Wi-Fi based mobile communication system will give higher throughput and packet delivery ratio as compare to earlier 4G mobile communication systems. Also the delay which is time required to transfer the packet from source node to destination node will gradually reduce. The interference will be very negligible as compared to other mobile communication techniques. Overall Wi-Fi based 5G mobile communication systems will provide better performance as compared to existing 4G mobile communication systems.

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