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Key Emerging Technologies of 5G Mobile Communication Network

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Abstract: *In the upcoming years, the 5G mobile communication network will be established across the globe aiming to remove all the obstacles in the communication network and provide a wireless world. In the near future i.e. [beyond 4G some of the prime objectives or demands that needs to be addressed are fast network, high capacity, Intelligent handover, service in remote areas, reliable service in crowded areas, pseudo outdoor communication, spectrum allocation, energy efficiency etc. that solves the existing problems in mobile communication network. This paper presents the results of detailed survey on 5G mobile communication and a study on key emerging technologies, challenges, and future aspects.*
Keywords: *Intelligent Handover, Pseudo outdoor communication*

I. Introduction

In the upcoming years, increase in data consumption is expected to be 30%, including a rising need of industries, health and education sector, this leads to the need of a next generation mobile communication network. In recent years, extensive 5G wireless communication rollout is occurring.
According to 3GPP [1] 4 major families of applications should be supported by 5G, they are:

- Enhance mobile broadband (eMBB)
- Massive machine type communications (mMTC)
- Ultra-reliable and low-latency communications (URLLC)
- Enhanced vehicle-to-everything communications (Ev2x)

Till now 5G is not explained, it is possible by integrating several techniques in the field of wireless communication. Some of the technical requirements of 5G are given [2]:

- Mobile data rate increased to thousands times
- User data-rate > 1Gbps
- 10-100 times number of devices connected as compared to 4G
- Increase in battery life

The above mentioned scenarios include high throughput, huge connectivity, improved spectral efficiency but also impose various significant design challenges to the deployment of general 5G networks. In order to meet the above mentioned challenges new emerging technologies, modulation techniques and multiple access schemes needs to be evolved and explored. Current modulation schemes are CDMA and OFDM used in 3-G and 4-G mobile communication networks. High power consumption and ISI (Inter symbol Interference) are the disadvantages of CDMA. OFDM over took CDMA IN 3G due to several advantages of OFDM like high data rate, network immunity to interference and ease of implementation. OFDM (Orthogonal frequency division multiplexing) [3] has been adopted in 4G networks which uses cyclic prefix (CP) to combat the delay spread and large occurring side lobe which in turn limits the spectrum utilization. For example in mMTC scenario sensor nodes transfer different types of data asynchronously in narrow bands while OFDM requires high synchronization between different users, otherwise there will be a large interference among adjacent sub bands.
Therefore, for future generation mobile communication network OFDM is not likely to be considered. Hence many researchers are undergoing a thorough study on key emerging technologies, challenges involved, projects and the future aspects along with a research to solve the issues for successful deployment of 5G.

FEATURES OF 5G:

- HIGH SPEED NETWORK: It is estimated that a data rate of 1Gbps or more will be experienced by the users in the 2020 [4].
- RELIABLE SERVICE IN CROWDED AREAS: Huge traffic accounts for DOS due to network overloading. Therefore, the aim of 5G is to give enhanced services and better connectivity in high traffic areas such as malls & metro stations etc [5].
- SERVICES IN REMOTE ALLOCATED AREAS: Remote places applications include smart city with remote meter reading, E-health, and video supervision [6].

- INTEGRATION OF NUMBER OF LOW POWER CONSUMPTION DEVICES: The aim of 5G is to support high number of low power consumption devices. [6].
- PSEUDO OUTDOOR COMMUNICATION: Indoor traffic originate more voice and data traffic but coverage of network and services provided in indoor areas is not at par to outdoor. A next generation network is to be designed to overcome these issues and provide equivalent services in indoor areas as compared to outdoor areas
- UTILIZATION OF WHITE SPECTRUM: The spectrum called White band spectrum is un-utilized the if it is utilized , the issues related to spectrum crisis will be solved to maximum extent.

II. Review

The work being done by academicians in the area of 5G mobile communication network is highlighted. 5G is one of the emerging technologies and therefore for the successful deployment of 5G, it marks the need to discuss the requirements, the advantages, challenges, disadvantages etc. The challenge includes both hardware and software. Till date 5G is not a defined standard for a lot emerging innovating areas . The key emerging technologies involved in 5G are described [7]. This work explores various types of networks and devices that are helpful and contribute to the successful deployment of 5G mobile communication network and also the role and impact of 5 technologies and they are milli-meter wave, DCA, smart device, massive- MIMO and M2M communication.

III. Key Emerging Technologies

Various future and key emerging technologies for the successful deployment of 5G-

OFDM (ORTHOGONAL FREQUENCY DIVISION MULTIPLEXING)-

OFDM has been adopted in 4G networks. In OFDM the total available bandwidth is so distributed among the subcarriers, orthogonal to each other. The pros includes high data rate, reduction in inter symbol interference, capacity increment and we get a flat channel response which is preferred in 4G. If we talk about 5G OFDM is not very good option due to the following disadvantages like CP (Cyclic Prefix) resulting in reduction in spectral efficiency, PAPR (Peak average power ratio) leading to performance reduction. [8]

FBMC (FILTER BAND MULTI CARRIER)-

An advancement of OFDM is FBMC in which array of filters are used instead of CP. A set of data parallel to each other is sent using a bank of filters. For Television White Spectrum and usage of spectrum flexibility in frequency domain is introduced. Fragmented spectrum and delay spread can be easily handled [9].

UFMC (UNIVERSAL FILTER MULTI CARRIER)-

In this technique OFDM and filter-bank model are used where filtering procedure is done on a group of subcarriers despite of doing it on each subcarrier as in FBMC. Bandwidth allocation is done by dividing the available bandwidth in number of sub-bands. Efficiently reduces the side lobe resulting in increase in performance of the system [10]

FASTER THAN NYQUIST RATE-

More data is sent in time domain and this intern increases the capacity. In this model a pulse at a rate faster in time domain is sent, leading to loss of orthogonality, ISI etc. Advanced detection technique is used for signal [11]

COGNITIVE RADIO-

A Cognitive radio is a very intelligent mobile communication system that considers environment in its methodology while taking the decisions. It can work with all the radio technologies. CR is very efficient when it comes to spectrum utilization as when the primary user is free , the users use the free spectrum. It is dependent on several parameters like types of data to be sent, channel availability, variety of modulation techniques, channel is ideal or not. Hence the need of designing a software to take on the requirements of the user comes into picture [12]

SMART ANTENNA-

In this technique with the help of adaptive beam steerable antennas we tend to improve the capacity at a very limited spectrum. It is the best technique to increase the speed and also capacity by reducing the effect of Co-channel interference and fading. Number of arrays of antenna are included whose elements are combined to form a beam that is movable to follow the desired user using the main beam. Ericsson has designed some array antennas operating at a frequency 900, 1800, 1900 MHz [13]

SPATIAL MODULATION-

It utilizes the index of the antenna transmitting the signal to enhance system's performance. Transmission of multiples of data using the index of antennas is introduced. The best performance is when spatial modulation is integrated with MIMO [14]

VLC (VISIBLE LIGHT COMMUNICATION)-

Data is transmitted using light -range (400 to 800) THz in this technique. It is the amalgamation of communication with illumination. Light is modulated with the data signal with the help of fast switching light emitting diodes [15]

FEMTO CELL-

According to research far more than 70% of data traffic and more than 50% of voice traffic arrive from indoor area. In this the signal is taken from the macro cell and is further propagated to the mobile which is connected to the femto cell as a home node base station. The range of the cell is around 10-50m [16]

IV. Future Aspects: Success Of 5g

1. DEVICE CENTRIC ARCHITECTURE: Different architecture for both outdoor & indoor communication.
2. MASSIVE MIMO: MIMO technology scales up to 100-1000's of terminals and antennas to a base station, focus the transmission and reception of signal energy into small regions of space, providing new level of efficiency and throughput
3. VISIBLE LIGHT COMMUNICATION: In this techniques light is used as a transmitter of signal channel is air and photo-diode is used as a
4. MILLIMETER WAVE: Transmit signals on whole new spectrum i.e. millimeter wave which uses higher frequencies than radio waves that have long been used for mobile phones. Will greatly increase the speed and wireless capacity
5. SMART DEVICE: 5G allows devices to consume far less power. 5G devices have the potential to last up to ten years without a change of batteries
6. M2M COMMUNICATION: With the advent of IOT, and its vision of a world where every device is connected, machine-to-machine (M2M) has become the cornerstone to its full realization.

V. Conclusion

The work provides an inclusive research based study on 5G mobile communication network highlighting the key emerging technologies current scenarios going on for the deployment of 5G and the future requirements in the field. The challenges faced are also outlined. The major concern proposed included validity of the new concepts and also the identification of new spectrum. The main objective highlights the need of a wireless world free from all the hindrances & a possibility of merging all the existing technologies with the future technologies with 5G and to bring a revolutionary change till the year 2020 where the concept of connectivity of anyone anywhere at anytime will be introduced.

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