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Green Communication Impact in 5G Wireless Cellular Networks: A Review

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Abstract: The rapid increase in mobile communication is coupled with the environmental problems. As the subscriber demands are increasing in near future, the evolution of 5G wireless cellular networks is witnessed.The fifth generation (5G) Wireless Cellular Network is expected to be available for users in 2020. As a result the energy consumption will be high, that will increase the emission of CO2. Green Communication aims to find the novel solution to improve the energy efficiency and reduction in the CO2 content in the wireless applications. The reduction of CO2 content is the main focus area of Green Communication. This paper gives a brief review of the various techniques available for Green Communication and will also discuss about the challenges associated with it.
Keywords: 5G Wireless Network, Green Communication, Energy Efficiency.

I. Introduction:

In the era of information technology and telecommunication, speed and energy consumption are the main challenges. CO2 content is increasing at the alarming rate due to energy consumption by the networking and communicating devices. Green Communication concept was put forward by the researchers to handle these issues. Green Communication stands for "Globally Resource Optimized Energy Efficient Network" Communication. Here main focus in on allocation of the resources in an optimal way so that energy efficiency of the cellular network is achieved. 5G will be available for users by 2020 as to solve the congestion and bandwidth issues of 4G. Also there will be high data rate and the capacity in comparison to 4G. Large number of device connection is there for 5G wireless network, that would result in high energy consumption. This will produce the CO2 content at high rate. Green Communication can play an important role to solve this issue.

This increase in CO2 content has many effects on health as well as on environment. The impact on environment can be direct and indirect. Information and Communication Technology (ICT) is consuming the 4% of energy and emitting the 3% of CO2 content[1]. So Green Communication applications can have great impact on lowering the CO2 content.

II. Technologies in Green Communication:

Some of the techniques of Green Communication include Cognitive Network, Device-to-Device Communication, Network Coding, Massive MIMO devices.

Cognitive Network-

Cognitive Network technology aims to improve the radio spectrum utilization. Main research area is spectrum-sensing cognitive radio where high quality spectrum sensing devices are to be designed[14]. Green Communication deals with the Green spectrum resource management. Network transmission performance is also improved with Cognitive Network. Here condition of channel for the user is perceived and then spectrum utilization is done in an optimal way. Spectrum Sensing, Waveform perception, Awareness of the Network, User needs are the main focus area.

Cognitive Radio is different from other radios due to its intelligence feature as the event includes planning, decision and implementation stage which makes it a efficient and smart wireless network. This technique is an important technique of the Green Communication because the self awareness and automatic learning differentiates it from other radio wireless networks. Cognitive technique utilizes a visibility meter to sense the interference due to the pass loss as path loss is dependent on the weather conditions as rain, fog etc.

Device-to-Device Communication-

Device-to-Device is the main interest topic in 5G as energy efficiency and the spectral efficiency are expected to be high with this technique. In D2D two nearby devices communicate with each other with limited base station involvement or without a base station to get involved in the communication. Till 4G, the D2D functionality was not a vital component in communication.

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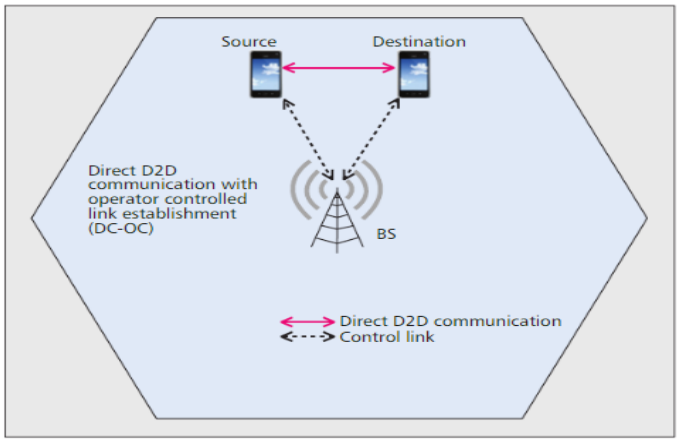

Fig1. Direct D2D Communication [2]

The Fig 1. illustrates how the source and destination devices communicate and exchange of data is done with each other without the involvement of BS. Here base station provides a control link to the source and the destination. In D2D communication, three modes are as dedicated, cellular and reuse mode. Selection of particular mode effects the efficiency of the network[3].

In 5G main focus is on high data rate and low latency. As D2D involves the direct link between the source and the destination so the latency is reduced and power will be saved in large amount[4]. This will cause the less energy consumption which will result in reduced emission of CO2 content. So the Device-to-Device Communication is a great candidate for the Green Communication.

Network Coding-

Network Coding mainly aims to improve the bandwidth utilization and energy saving. This also improves the network throughput. In [5], this Network Coding technique was put forward. Here the intermediate nodes handle the information and simple routing information is used to code as a result the bandwidth utilization is achieved[6]. Main advantage of Network Coding is to reduce the complexity of coding and decoding and improvement in the link utilization.

Multiple Input and Multiple Output System-

Multiple-input and Multiple-Output or MIMO exploit the multipath propagation with the multiple transmission and receiving antennas to multiply the capacity of the radio link[7]. MIMO is an important element in wireless communication standards such as WiMAX(4G), Long Term Evolution (4G LTE) and IEEE 802.11n and IEEE 802.11ac (Wi-Fi). Massive MIMO systems employs more number of antennas than the MIMO systems[8].

In 5G, Massive MIMO is used as it increases the capacity density and the sector throughput. For this the large number of antennas are used at both transmission and reception site. Number of users having single antenna equipment is being served by the base station simultaneously. [9] discusses how the massive MIMO technique is used for energy efficiency in 5G. High throughput, less latency, high capacity and more energy efficiency are the outcomes of massive MIMO systems[10].

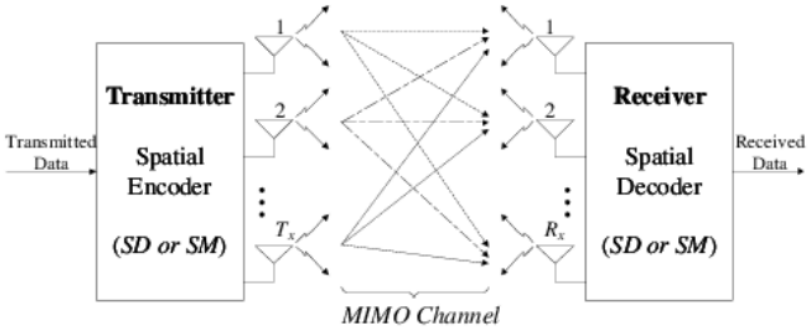

Fig 2. Massive MIMO [11]

Power consumption is reduced because of the efficiency of the antennas. So in Massive MIMO main focus area is the selection of the antennas. As this selection will result in energy efficiency which will decrease the emission of CO2 content and this technique becomes a part of Green Communication.

III. Challenges in Green Communication-

Although Green Communication has many benefits but some challenges are also associated with it. Some challenges are as follows:

Antenna Selection in Massive MIMO:

In 5G communication, the Massive MIMO is used for energy efficiency[12]. As Massive MIMO employs a large number of antennas, a proper selection of energy efficient antenna is challenging because these antennas will increase the power consumption. This selection of antenna will also impact the emission of CO2 content.

Reliability:

Cellular Network becomes efficient but not reliable after using the energy saving techniques. No encryption technique works for the energy. So in the cellular network the energy state of the device is more prone to the security issues. Reliability of network is a challenge in Green Communication.

Expensive:

The techniques used in Green Communication are somewhat expensive because of the infrastructure and the components associated with these techniques. Energy saving techniques are also used in Green Communication which are also expensive. So overall cost is high than the existing techniques of wireless network.

Throughput:

There is a trade-off between the transmission power and data rate in Green Communication. In 5G, high data rate is required with low latency. Bandwidth optimization is also an issue in Green Communication techniques. Expansion of the bandwidth will reduce the energy consumption [13]. Spectrum efficiency is the main challenge in the Green Communication which is addressed by many researchers.

IV. Conclusion-

To meet the subscriber needs in future, the 5G wireless network is in evolving state. But this will result in high energy consumption that will increase the emission of CO2 content in the atmosphere. To handle this situation the Green Communication can play a great role. Some techniques of Green Communication are discussed in this paper. Also some of challenges associated with Green Communication have also been highlighted which are open for the further research.

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