**MULTIHOP D2D COMMUNICATION TO MINIMIZE AND BALANCE SAR IN 5G**

**Abstract:**

5G is the 5th generation mobile network. It is a new global wireless standard after 1G, 2G, 3G, and 4G networks. 5G enables a new kind of network that is designed to connect virtually everyone and everything together including machines, objects, and devices. But this system causes high specific absorption rate (SAR). Hence, we introduce a novel technique.

In this paper, we propose an elegant method of band selection with appropriate data rate for multi-hop packet routing, to minimize and also to balance the transmission power and hence the associated EMF effect on us in terms of the Specific Absorption Rate (SAR). Theoretical analysis has been presented for linear networks that results an upper bound on the number of hops permitted for a given spectrum band. Simulation results on random networks show that the proposed technique achieves a better improvement in terms of SAR, compared to the conventional direct communication via base station.

**Keywords:**  Specific Absorption Rate (SAR) value, EMF effect, Multihop packet routing, 5G systems.

**Existing method:**

To improve the network performance, multi-hop D2D communication has recently attracted many researchers to forward packets via users’ devices serving as relay nodes which results improved energy efficiency and outage probability. Various incentive schemes and policies have proposed in the context of ad hoc networks. The authors proposed a novel energy incentive-based technique of preferential band selection using cognitive radio for ad hoc IoT networks, and Multihop D2D networks as well, to motivate nodes to serve as relay nodes to support multi-hop communication preserving its energy resource, and to achieve significantly better QoS and coverage.

**Drawbacks:**

* High SAR values.
* Low energy efficiency and outage probability.

**Proposed method:**

In this paper, we propose a new algorithm to control SAR values. SAR value is dependent on the distance of separation of the body and the radiation source.

Since, the effects of EMFs on living beings depend on the transmission power and the frequency of operation as well, it is important to investigate the relation between the two. From information theoretic point of view, Shannon-Hartley theorem says that the error-free information transmission rate k in bits/sec is upper bounded as given by:



By using this formula, the SNR value will be obtained. Where B is the channel bandwidth in Hz, and SNR is the signal to noise power ratio at the receiver. So, minimum SNR required to receive data at a rate of k bits/sec using the SNR equations. we are going to consider the power value from which we are going to derive the SAR value which is given by:



By using the above values, the SAR values is obtained which is minimal. The block diagram of proposed method is given below:

Creation of network

Calculation of SNR and power values

Calculation of SAR minimum values

Plotting relevant graphs

**Advantages**

* Provides less SAR value.
* Maintains better energy efficiency.

**Hardware & Software Environment:**

**Software:** Matlab 2018a or above

**Hardware:**

**Operating Systems:**

• Windows 10

• Windows 7 Service Pack 1

• Windows Server 2019

• Windows Server 2016

**Processors:**

Minimum: Any Intel or AMD x86-64 processor

Recommended: Any Intel or AMD x86-64 processor with four logical cores and AVX2 instruction set support

**Disk:**

Minimum: 2.9 GB of HDD space for MATLAB only, 5-8 GB for a typical installation

Recommended: An SSD is recommended A full installation of all MathWorks products may take up to 29 GB of disk space

**RAM:**

Minimum: 4 GB

Recommended: 8 GB

**LEARNING OUTCOMES**

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* What is EISPACK & LINPACK
* How to start with MATLAB
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* Basics of wireless communications
* How system modal can be formed in Matlab.
* Construction of algorithm according to system modal
* Analyzing and visualization of plots.
* Phases of data transmission:
* Generation of input signal
* Construction of transmitter
* Formation of channel
* Construction of receiver
* About SAR
* About D2D communications
* About Multihop communication.
* About network formation.
* About 5G technology.
* About Beam forming.
* How to extend our work to another real time applications
* Project development Skills
  + Problem analyzing skills
  + Problem solving skills
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