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Energy Optimization Mechanism to Improve Energy Efficiency of Mobile Device Interface for Mobile System

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Abstract

Wireless communication and networking technologies use higher speed network interface devices. These wireless network devices are the power hungry component of the cellular device. The results of power consumption leads to high operating cost and a greater failure rate of the device. This has become a major cause of concern which has imposed challenges towards the development of greater performance system. The key concept to decrease power consumption is to disable all the sub-antennas and their RF chains. The technology employed by wireless communication devices to improve the capacity, is to use Multiple-Input
Multiple-Output (MIMO) scheme. This paper, initially discusses the basic mechanism of power management. Then, we introduce a novel scheme that effectively resolves the issue of reducing energy per bit. We utilize Matlab tool to assess the energy efficiency of receiving antennae. The outcome shows that antenna management can successfully diminish energy per bit to equate with a static MOBILE DEVICE design that keeps all antenna apparatus active.

***Keywords*;** *Energy dissipation, Wireless Local Area Network (WLAN), mathematical model, Fourth Generation (4G) network*

I. INTRODUCTION

The easy availability of inexpensive mobile devices with features to process multimedia signal, accomplished with ubiquitous higher-speed networking technologies to process multimedia contents has increased the demand to stream multimedia signals in mobile. In the coming times Mobile equipment's can be considered as the main cause for evolution of wireless broadband, because of to their ability to enhance the channel capacity [1] [2]. The increment in the quantity of mobile users has prompted an increment in data traffic; thus, the quantity of base stations (BSs) has expanded to address the issues of mobile users. Reference [3] defines the development in the number of BSs in developing districts somewhere around 2007 and 2012, and predicated that the aggregate number of BSs would increment by more than 2 million inside of this period. The majority of the past studies on this subject have concentrated on enhancing both system channel capacity as well as data rates, while ignoring the growing demand of mobile network systems for energy. This expanding energy demand has encouraged significant investigation on the subject of "green communication".

Antenna diversity apparatus is utilized as a part of wireless communication frameworks to battle the impacts of fading. In the event that various autonomous duplicates of the same signals are available, we can add them to an aggregate signal

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with better quality - regardless of some of the portion of duplicates show low quality. Antennae equipped with diversity apparatus at the recipient end is quite common, which has been discussed over more than 50 years. The various copies of distinctive signal are linearly consolidated, i.e., weighted and included. Following which the corresponding signal at combiner yield can be recovered and decoded. The designed weights for the above combining are communicated to the wireless channel. In the event that there are N receiver antennae components, diversity qualities request, that depicts the efficiency to minimize fades, is N; as such, the diversity direction associated to slope of SNR appropriation at the combiner yield. The numerous antennae increases the normal SNR at the combiner yield.

During the 1990 investigations were concentrated more on transmit diversity. Here various copies of the transmitted signal which can be recognized by the transmitter are transmitted over the channel, such that it outputs the same gain with respect to recipient diversity. On the other hand if the channel is unknowns to the transmitter, different procedures, similar to delay diversity or space time coding, must be utilized.

This paper talks about the issue of energy productivity and power management in Mobile Device frameworks utilized as a part of wireless communication systems. The various receiving antennae in Mobile device frameworks can be used in two distinct ways. Firstly is the formation of a highly efficient antenna diversity framework; and secondly in the utilization of the different receiving antennae in order to transmit of a few parallel information signals to expand the channel capacity of the frameworks. The remaining paper is arranged as mentioned. Section II discusses the literature review in brief while section III provides background knowledge on mobile device technologies. Section IV presents the proposed framework of antenna management along with pseudo code and implementation method. Section V presents the results of simulation along with the explanation followed with section VI which concludes the paper.

II. LITERATURE REVIEW

This section provides the existing work done by other others, related to the antenna management system in 3 different directions used for mobile device technologies.

A. Yang et al. [10] presented analysis for huge mobile device system with circularly spread antennae with respect to its performance and location optimisation here author considered a circular antenna array. The performance parameters are transmitted power and path loss exponent on system. This results shows that huge mobile device which are circularly distributed performs better than centralized massive mobile device system. J.Li et al. [11] suggested on increasing the number of transmitter and receiver antennas to improvise the performance of location detection in mobile system. Here the authors intend to reduce the errors which arise due to multiple paths as well as approximation of position of mobile terminals by using non-linear equations.

H.Jiang et al. [12] proposed a mobile equipment supported hand off technique for Communication Based Train Control(CBTC) systems to decrease the latency due to handoff. The performance factor of handoff along with transmission delay, error rate of frame during handoff signalling, and the desired interstice results shows that the presented method can diminish handoff latency of CBTC services compared to traditional schemes. H.Jiang et al. [13] analysed a heterogeneous network in an asymptotic atmosphere where the network size grows big with fixed ratios of base station antennae and size of network(MUEs and SCAs) using wireless data traffic. Results were analysed to give precise calculations for uplink and downlink power transmission and the coded vectors for the mentioned conditions. Final results were used for

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comparison with different network architecture and to validate the results.

M. Radmard et al. [14] performed data association to improvise the quality of localisation. The key concept to predict location correctly is to combine the various inputs and outputs along with the passive coherent location, however the authors have considered the situation of MISO. in general. Y. Zhang et al. [15] presented a novel method like Interference alignment (IA) to achieve optimum amount of freedom in wireless communication system through efficient management of intervention. The authors presented an innovative restricted IA scheme to improve the throughput of multi cell networks by using the heterogeneous path loss. Zheng et al. [16] presented a view that using multiple antennae bot gains (increasing diversity and degree of freedom) can be achieved. But there is a compromise on each based on the coding scheme. For example for a Rayleigh channel it gives a simple distribution of the ideal curve and used for evaluation of existing multiple antenna schemes.

III. BACKGROUND

The background on mobile device techniques, specifically the devices which use spatial to enhance link capacity by sending free data streams. Mobile device innovation accomplishes the multipath performance by utilizing different antenna at the transmitter and also receiver part and by giving Spatial Diversity to significantly build the channel limit. By utilizing the spatial differences Mobile Devices can permit numerous receiving antennas to send and get different spatial streams in the meantime. The two fundamental essential formats of mobile device are:

A) Spatial Diversity:-

Spatial diversity qualities utilized as a part of this narrow sense states to the transmit and receiving diversity. The two techniques are employed to give changes in the signal to noise ratio. Hence represented by augmenting the quality of the framework for different types of fading [4]

B) Spatial Multiplexing:-

For utilizing upper data rate capacity, distinctive paths to convey additional traffic i.e. escalating the data throughput ability, the idea of spatial multiplexing is utilized. In any case, by utilizing the numerous antennas at transmitter side and at collector side at the same time and because of the presence of different RF chains, the circuit power utilization increments exponentially which gets to be as extreme issue in short-range communication situations like 802.11-based WLAN etc.

C) Mobile Device Antenna Configuration:-

Figure 1 indicates the mobile device antenna arrangement, for single user with multiple transmitter and multiple receiver antennae.

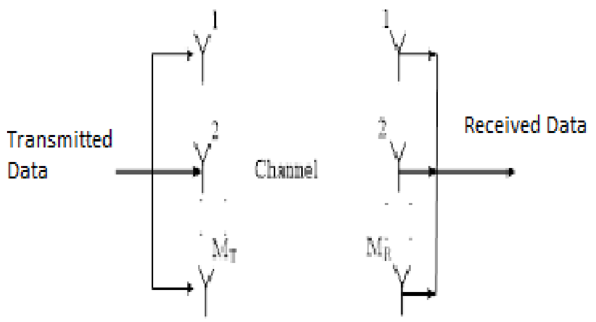

Figure 1:Mobile Device Antenna configurations for single users

In principle, utilizing numerous antenna transmit components can accomplish both beamforming and diversity gain. If the reception antennas apparatuses are put far from one another, most extreme diversity gain increase can be accomplished at the same time, because of the grating lode projection issue, the achievable beamforming addition is constrained. Then again, if the inter component spacing in the receiving antenna exhibit is little distance, most extreme beamforming can be obtained, however the diversity gain increase will be restricted as signals from distinctive reception antenna components will be exceedingly correlated.

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D) Shannon's Capacity:-

Generation of the mesh is an important step Channel limit is concerned with the data handling capacity limit of a given channel. It is influenced by:

- The weakening of a channel which shifts with frequency and in addition channel length.
- The noise affected into the channel which increments with separation.

E) Mobile Device System Model:-

Multiple-Input and Multiple-Output(MIMO) as shown in Figure 2, is a wireless system characteristics that utilize many antennas at the transmitter and receiver to increase the capacity of a radio connection to adventure multipath propagation. It has turned into a vital component for various communication principles, for WiFi such as IEEE802.11n and IEEE 802.11ac , 3G such as HSPA+ and 4G standards like WiMAX and Long Term Evolution.

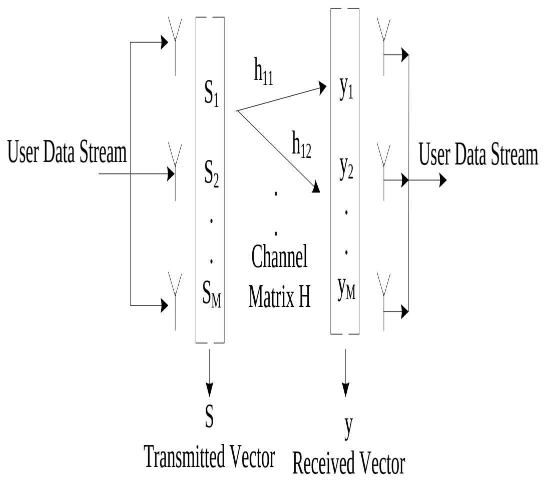
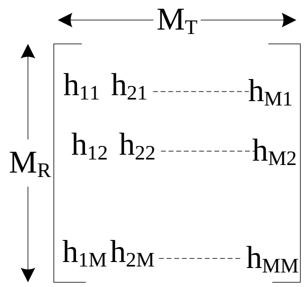


Figure2: Multiple Input Multiple Output Device

Where

$y = hx + n$

Where x is the stream send by transmitter , y is the stream received at the receiver and n is the white Gaussian noise and h=



hij is a complex channel fading co-efficient that represents the channel attenuation between the i^{th} transmit and j^{th} receive antenna.

F)Capacity of Mobile Device Channels:-

In this section, we will look at the limit of mobile device fading channels and deliberate about transceiver designs that focus on the multiplexing gains from the channel. We especially concentrate on the situation where transmitter is unaware about the channel acknowledgment. In the quick fading MOBILE DEVICE channel, we demonstrate the following:-

1. The strength of IID Rayleigh fast fading channel changes as n_{min}log SNR bits/s/Hz at high signal to noise ratio. Here n_{min} represents the least number of the transmitting and receiving antenna and also called as degree-of freedom-gain.
2. At other signal to noise ratio the strength of the link changes linearly with $n_{min,}$ as a result of the combining of power gain and degree-of-freedom gain.

y = Hx + n

Where x is a random vector representing the transmitted signal and n representing normalized noise. If P represents the transmitted power per symbol then the capacity of the channel is given as

$C = \log_2 (I_M + HQH^H)$ b/s/Hz

We consider a frequency flat MIMO channel to calculate its capacity. Where I_M is a unit matrix N_R X $N_{R,}$ H is the channel matrix N_R X N_T and Q= $E\{ss^H\}$ the covariance matrix of transmitted signal x

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satisfying the transmit power constraint $Tr(ss^H)=N_T$. Consider specific case when we have users transmitting at equal power over the channel and the users are *uncorrelated* (no feedback available)

to each other than under such case the capacity of channel is given as

$C_{EP} = \log_2 [I_M + (P/M_T) HH^H]$ b/s/Hz

Which was shown by Telatar as the optimal choice for *blind* transmission.

Foschini and Telatar also showed that as M_T and M_R grow,

$C_{EP} = \min (M_T, M_R) \log_2 (P/M_T) + \text{constant}$ b/s/Hz

IV. PRPPOSED SYSTEM

A)Antenna Selection Algorithm

The main mechanism for an optimal selection of the reception antenna components is a comprehensive quest of every single possible combination which results in the ideal signal to noise ratio (in case of diversity) or channel capacity (in case of spatial multiplexing).

The easiest selection algorithm depends on the energy of the signal received at receiver and is very efficient for systems employing diversity qualities. On the other hand, for spatial multiplexing, this methodology separates. The power based selection gives equivalent results as the capacity based determination, only in case of, if around half of all channels acknowledge. Hence the subsequent reduction in channel capacity is very prominent. This conduct is translated physically: the objective is for beneficiary to independent the distinctive information signals. Subsequently it's bad to utilize the information from two different antennas, which are exceptionally correlated, regardless of the possibility that both have high SNR.

Taking into an account of these considerations, an option class of technique has been recommended by Choi et al., [5]. Here the assumption made is the two rows of H is indistinguishable. As both these rows are carrying similar data its possible to eliminate either of these rows without making compromise on the transmitted vector. Along with this if the rows have dissimilar power; we erase the row with less power. At the point if there are no indistinguishable rows, we search down two lines with most correlation or relationship and after that erase the line having less power. Using the above method we arrive at the channel framework $H^{\sim}$ whose lines have least connection and most extreme power. This strategy accomplishes capacity inside of tenths of a bit/s/Hz. A related degree comparative methodology, in view of the shared data either between transmitter and receiver antenna, has been proposed separately by [6].

Another scheme was proposed in [7], [8], and [9]. It makes N − L goes of a circle that dispenses with the most noticeably bad antenna reception apparatus, where the file p of the most exceedingly worst receiving antenna wire is,

$$\tilde{p} = \arg\min_p \underline{H}_p \left[\underline{I} + \frac{E_8}{N_0} \underline{H}^{\tau} \underline{H} \right]^{-1} \underline{H}^{\tau}_{-p}$$

Where $\underline{H}_{-p}$ is the p-th row of H.

B)Proposed system with Implementation

In order to reduce the power consumptions and increase power efficiency an efficient Power Saving Mechanism is used for mobile devices. The mechanism involves restricting the subset antennas and its subsequent RF chains for efficient power saving.

This section provide the pseudo code for implementation technique as given in procedure 1, 2, 3 and 4 .

Procedure 1 gives the detailed pseudo code for data bit rate, here the input given is the of number of transmitter and receiver antennas. Then the output is the data bit rate transmission through channel. Here the assumption is that the number of transmitting

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and receiving antennas has to be same then only will it perform the power optimization techniques. Otherwise, this code gives an error that the number of transmit and receive antennas has to be equal.

```
----------------Procedure: 1----------------
Name: Pseudo code for Data bit rate;
Input: nTx, nRx;
Output: Data bit rate;
    1.  Start
    2.  If no. of Tx and Rx equal
    3.  Perform Power_Optimization;
    4.  Else
    5.  Display erordlg"nTx and nRx must be equal";
    6.  End;
```

Procedure2 explains the power management system technique. Here, the input image, scale, energy bit and the total power transmitter is taken as input. Then the output calculated is total energy per bit per data rate. In this procedure, the input image is taken and initialized with different data transmit rate along with energy of each bit.

```
------------- Procedure: 2-------------
Name: Pseudo code for Power management;
I/P: Image(I), Scale, Energy per bit(Ebit), Transmitted Power(Ptx);
O/P: Optimum Energy per bit(Eb)/Data rate;
    Start
    The input image I is read;
    Various data transmit rates initialized;
    Energy of each bit is calculated and initialized;
    Total energy calculated;
    Various SNR values created;
    Tx and Rx antenna initialized;
    Multiplier created for each antenna ;
    BPSK modulation applied;
    Rayleigh channel applied ;
    White Gaussian noise added;
    Eb calculated;
    Configure Tx;
    Configure Rx;
    Equalization matrix created;
    Image I is received;
    The no of errors generated is counted;
    The outputs are plotted;
    End;
```

Procedure 3 shows the power optimization technique. Here, the input is taken as number of transmitter and number of receiver, the data to transmit, the total transmit power and bit power to optimize the power utilized by the antenna trans receiver system. The initial stage is to initialize all the parameters as well as take an input image. Then calculated the power P, after calculation of P, transmit image through channel and add white Gaussian noise to it. Finally calculate the number of bits required to transmit the data from transmitter to recover original image through a wireless channel.

```
------------------ Procedure: 3------------------
Name: Pseudo code for Power Optimization;
Input: Nt, Nr, Data, Transmit_power, Bit_power;
Output: Power Optimization;
    Start
    All parameters;
    Calculate P;
    Choose the transmitter;
    Apply channel;
    Calculate R;
    Calculate Wopt;
    Calculate No_bits;
    End;
```

V. RESULTS AND DISCUSSION

Here in this section we discuss the results obtained from the simulation of the proposed model, which is evaluated and validated. Here, the number of transmitter and receiver is selected as 5. Figure3 gives the number of bits received vs. transmit power, i.e., a plot of data rate to the optimal transmit power. It can be seen that as we increase the power needed for transmission, the no of bits received at the receiver increases. It is also observed that as the no of transmit and receive antenna increases there is an increase in the data transmit rate.

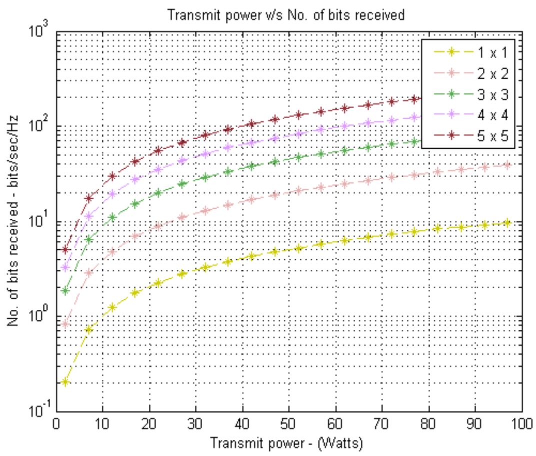

Figure3. Mapping of transmit power versus the No. of bits received

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Table 1. Shows the input image taken for experiment then applying the energy optimization technique to the image, adding a white Gaussian noise to the image and finally recovered the original image as output.

Table 1. Show Input Data, Applying Energy Optimization and Received Data

Input image	Apply energy optimization	Received Image
		

We investigate different situations for valuation, utilizing synthetic channels in case of both consistent and irregular traffic. Here a static system is used for evaluation. The power per bit is evaluated for transmitter which exhibits antenna management and transmits 1000 data segments to receiver which also exhibits antenna management. Under both the situations i.e. consistent and irregular traffic we consider various data rates varying from kilobytes to hundreds of Megabytes.

VI. CONCLUSION

A power optimization algorithm is presented in this paper for MIMO systems. The algorithm enables power saving by utilizing antenna management for both transmitter and receiver and hence maximizing energy efficiency for mobile devices.

For a given data rate and antenna configuration the mentioned optimization model using antenna management policy is able to optimize the transmit power by estimating and calculating the minimum energy per bit. The validation and experimentation was done using MATLAB-based simulation. Our results showed that antenna management is used at both the ends it can achieve around13% of energy per bit reduction and if used at one end can achieve around 21% of energy per bit reduction.

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