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# Throughput Maximization in Multiuser Wireless Powered Communication Network by Using Energy Harvesting Technique

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***Abstract:*** **WPCN (wireless powered communication network) is the newly emerging network in which an access point called hybrid access point (HP) broadcast energy in the downlink and in the upper link wireless information transfer take place from sensors to hybrid access point. A protocol called "harvest-thentransmit" protocol is proposed where all users first harvest the wireless energy from the H-AP, in the downlink (DL) and then send their independent information to the HAP in the uplink (UL) by time-division-multiple-access (TDMA).A set of relay nodes used in the network enhances the over all throughput than sum throughput and common through hput. More energy efficient network can be got by using relay nodes. Simulation result showing the priority of the network that using relay nodes than other ordinary wireless sensor networks.**

***Keywords:*** **wireless powered communication networks, throughput maximization, energy harvesting, relay nodes.**

## I. INTRODUCTION

Energy-constrained wireless networks, such as sensor networks, are usually powered by fixed energy sources just like batteries. These batteries have limited life time. So it has to be replaced or re charged. But it is often impossible particularly when the sensors are in toxic environment or inside human body that is in the case of a body sensor. A new technique called Energy harvesting technique can be used to improve the life time of the network. By using this technique we can recharge the batteries. Energy harvesting technique is a new technique in which sensors scavenge energy from the environment and that energy will use to recharge the batteries and also to power the whole network.

In this paper, we can see a new type of WPCN as shown in Fig. 1, in which one hybrid access point (H-AP) with constant power supply (e.g. battery) coordinates the wireless energy transmissions to/from a set of distributed users through relay nodes that are assumed to have no other energy sources. All users are each equipped with a rechargeable battery and thus can harvest and store the wireless energy broadcasted by the HAP(hybrid access point).Unlike from prior works on WPCN [1] which focused on the simultaneous energy and information transmissions to users in the downlink (DL) without relay nodes, in this paper we consider a different setup where the H-AP broadcasts only wireless energy to all users in the DL while the users transmit their independent information using their individually harvested energy through relay nodes.A wireless sensor network consists of many components like low-power, low-cost sensor nodes, which can perform sensing different information, simple computation, and can do transmission of sensed information. Long distance transmission by sensor nodes may not energy efficient, because energy consumption is a super linear function of the transmission distance. One approach to prolong network lifetime while preserving network connectivity is to deploy a small number of powerful relay nodes whose main task is communication with other sensor or relay nodes But the current technology tells long distance transmission in WSNs is very costly, since energy consumption is proportional to d^k for where d is the transmitting over distance, and k is a constant in the interval, depending on the media. Relay nodes are low power nodes it does not change or process the information received by it. Relay nodes just forward the received data.

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## II. RELATED WORKS

Wireless energy transfer based on magnetic resonant coupling was a technology to give energy to sensor nodes in a wireless sensor network (WSN)**.** Charging sensor node one at a time posses scalability problems Recent advances in magnetic resonant coupling tells that more than one node can be charged at the same time. So by using the recent advances in magnetic resonant coupling we can charge the batteries of sensor nodes in WSN [2] **.**Wireless networks could be self-sustaining by harvesting energy from the ambient radio-frequency (RF) signals. Researchers have made progress on designing circuits and low power devices for RF energy harvesting suitable for some wireless applications. The low-power mobiles in the secondary network, called secondary transmitters (STs) It will harvest ambient RF energy from transmissions by nearby active transmitters in a primary network; these transmitters called primary transmitters (PTs).That will enable secondary users to harvest energy by reusing the spectrum of primary users in the CR network [3].There is a fundamental trade-off between the rates at which energy and reliable information transmitted over a single noisy line. Technological inspiration for this problem is provided by power line communication, RFID systems, and covert packet timing systems as well as communication systems can be used to scavenge received energy[4].In the case of wireless information and power transfer across a noisy coupled-inductor circuit, which is a frequency-selective channel with additive white Gaussian noise[5] the optimal tradeoffs between the achievable rate and the power transferred is characterized the given total power available. When considering a hypothetical meeting of Claude Shannon and Nikola Tesla at the same circuit Tesla designed it to deliver power wirelessly to the load, Shannon wants to use it to send information.

Wireless power transfer (WPT) is a solution to provide convenient and perpetual energy supplies to wireless sensor networks.WPT can be implemented by using various technologies. Inductive coupling, magnetic resonate coupling, and electromagnetic (EM) radiation, can be used for short, mid and long-range applications. For SWIPT(simultaneous wireless information and power transfer) EM or radio signal can be used. Radio signal can carry energy as well as information at the same time in a link.

## III. SYSTEM MODEL

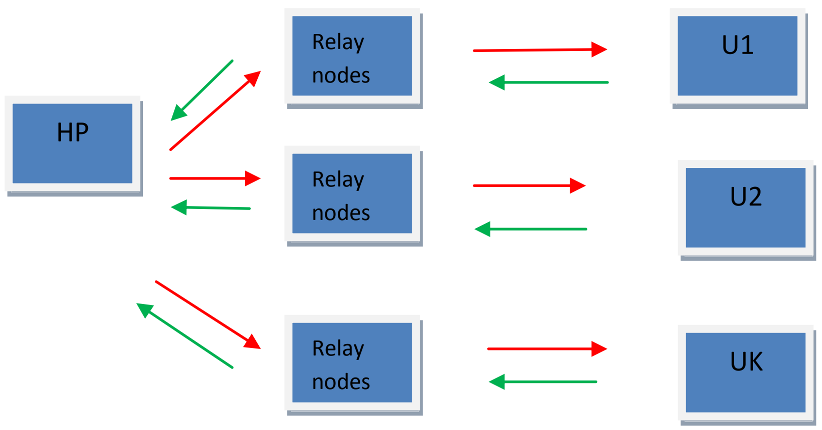


**Fig 1: System model**

As shown in Fig. 1, this paper considers a WPCN (wireless powered communication network) with WIT in the UL and WETs in the DL. The network consists of one HAP and K users (e.g., sensors) ,that is denoted by Ui, i = 1, · · · , K. It is assumed that the H-AP and all the user terminals are equipped with single antenna each. It is further assumed that the H-AP(hybrid access point) and all the users operate over the same frequency band. All user terminals are assumed to have no other embedded energy sources. Thus, the users need to harvest energy from the received signals broadcasted by the H-AP in the DL, this is stored in a rechargeable battery and then used to power operating circuits and transmits information in the UL.

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## IV. SIMULATION RESULT

Fig. 2 shows the throughput over number of users, K. It is assumed that K users in the network are equally separated from the H-AP according to the equation Di = DK K × i, i = 1, · · · K, where DK = 10m. The transmit power at the H-AP fixed as PA=20dBm and the path loss exponent are set to be as α = 2. In addition, compared with the throughput achievable by equal time allocation (ETA), i.e., τi = 1K+1, i = 0, · · · , K, as a low complexity time allocation scheme. It is observed that both the normalized maximum sum-throughput by solving (P1) and the maximum common-throughput by solving (P2) decreases with increasing K.But the enhanced throughput is higher than other throughput.

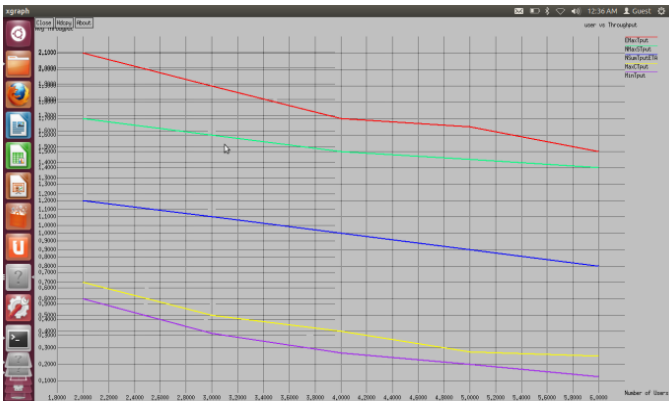

**Fig 2:Through put vs no.of users**

(P1): max (τ) Rsum(τ) s.t $\sum_{i=0}^{k} \tau i \; \tau i \geq 0$ (1)

the achievable UL throughput of Ui

$$R_i(\tau)=\tau_i \log_2(1+\frac{g_i p_i}{\Gamma \sigma_2}) \quad (2)$$

$$Rsum\ (\boldsymbol{\tau}) = \sum_{i=1}^{k} Ri(\tau) \quad (3)$$

$$(P2):\frac{\max}{\bar{R},\tau}\bar{R}$$

s.t. Ri ($\boldsymbol{\tau}$ ) ≥ R, i = 1· · · K,

$\boldsymbol{\tau}$ ∈ D, (4)

$\bar{R}$= ½( Rmin + Rmax) (5)

By fixing PA = 20dBm, Fig. 3.shows the throughput comparison for different values of the common path loss exponent α in both the DL and UL in the same WPCN as for Fig.1from the figure it can be see that the enhanced throughput(throughput with relay nodes) is higher than all other throughput when the path loss exponent increases.

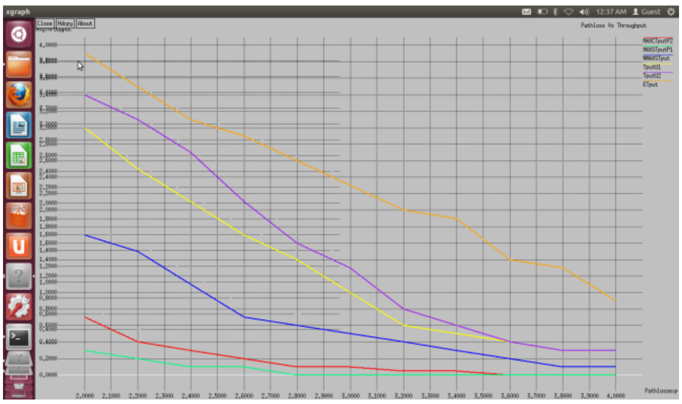

**Fig 3: throughput vs path loss**

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Fig. 4 shows the maximum sum-throughput versus the maximum common-throughput in the same WPCN with K =2, D1 = 5m, and D2 = 10m for different values of transmit power at H-AP, PA, in dBm, by averaging over 1000 randomly generated fading channel realizations, with fixed α = 2. As shown in Fig. 4, when the sum-throughput is maximized, the throughput of U1 dominates over that of U2 .It is also observed that the maximum common-throughput for the two users is smaller than the normalized maximum sum-throughput also the enhanced throughput is higher than all the other throughput.

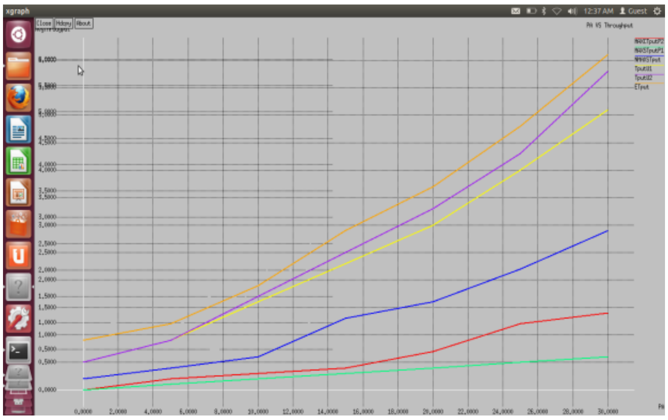

**Fig 4: comparison of throughputs**

## V. CONCLUSION AND FUTURE WORK

This is a new type of wireless powered communication network using harvest then-transmit protocol, where the H-AP first broadcasts wireless energy to distributed users in the downlink and then the users transmit their collected information to the H-AP in the uplink by TDMA.By using relay nodes the wireless energy transfer and wireless information transfer taking place through it. So that the throughput can be maximized and the network is more energy efficient. The through put is higher than sum throughput and common throughput.

One approach to prolong network lifetime while preserving network connectivity is to deploy a small number of costly, but powerful, relay nodes whose main aim is communication with other sensor or relay nodes Replacement of these relay nodes are costly. In future this battery powered relay nodes can be replaced by energy harvesting relay nodes also number of relay nodes can be reduced by replacing it by more powerful single mobile sensor node.

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