RESOURCE SHARING IN MULTI-PARTYWIRELESS POWER-DRIVEN ANNOUNCEMENT NETWORKS WITH USER COOPERATION

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ABSTARCT:

In Wireless powered communication networks (WPCNs), Energy quandary has always been a extraordinary undertaking for long-term operation of wi-fi networks. Traditionally, this problem has been treated with the aid of designing energy conservation strategies for minimizing power intake of gadgets. Although those electricity minimization techniques provide gadgets and networks with extended lifespans, the genuine hassle of energy scarcity stays unsolved and the community universal overall performance is likewise compromised due to the prudent use of power. Moreover, devices ultimately end up being battery-depleted because strength-conservative strategies are only in a position to put off the unavoidable battery exhaustion. In this kind of case, battery recharging or opportunity is deemed a possible answer, despite the fact that inconvenient in maximum situations. With in recent times's exponential increase of wi-fi technology and the rapid movement in the direction of the so-referred to as Internet of Things (IoT), the want for a reliable strength supply is more tangible than ever. Recently, strength series from the surrounding surroundings has acquired large interest in studies communities. This approach, that's called power harvesting is a sustainable answer for prolonging the lifetime of wi-fi networks. Besides traditional power harvesting resources together with solar, wind, vibration, and so forth. Harvesting strength from radio frequency (RF) signals has drawn large studies interest in latest years as a promising manner to triumph over the energy bottleneck. RF-enabled wireless electricity transfer (WET) is a controllable, solid, and coffee-fee method for charging wireless devices. Lately, the mixing of WET with wireless communication networks has introduced approximately the emergence of an exciting studies place, namely, wireless powered verbal exchange network (WPCN), wherein community customers are powered thru a hybrid get admission to factor (HAP) which transfers wireless power to the users further to serving the functionalities of a conventional access factor. During the last couple of years, WPCN has been one of the maximum attractive topics of research within the problem of wi-fi communications and this newly- emerged paradigm is predicted to play a chief function in the upcoming IoTthe harvested electricity variessubstantially amongst customer nodes (UNs), ensuing in throughput unfairness. Since the harvested power is restrained, each UN ought to strategically allocate the electricity used for forwarding the alternative nodes' statistics and for transmitting its non-public information, which similarly aggravates the worldwide unfairness in phrases of throughput. In this paper, we leverage man or woman cooperation in multi-hop transmission to decorate the throughput fairness. We formulate the equity problem because the max-min throughput with resource allocation, that is NP-hard. We layout an approximate set of guidelines to cope with this hassle. The theoretical proof and the simulation consequences each display that the proposed set of rules provides tight better and lower bounds for the pinnacle-rated answer. Compared with the benchmark strategies, our proposed method considerably complements the throughput fairness for WPCNs.

INTRODUCTION:

Radio frequency (RF) energy transfer and harvesting techniques have recently become alternative methods to power the next generation wireless networks. As this emerging technology enables proactive energy replenishment of wireless devices, it is advantageous in supporting applications with quality of service (QoS) requirements. In this paper, we present a comprehensive literature review on the research progresses in wireless networks with RF energy harvesting capability, referred to as RF energy harvesting networks (RF-EHNs). First, we present an overview of the RF-EHNs including system architecture, RF energy harvesting techniques and existing applications. Then, we present the background in circuit design as well as the state-of-the-art circuitry implementations, and review the communication protocols specially designed for RF-EHNs. We also explore various key design issues in the development of RFEHNs according to the network types, i.e., single-hop networks, multi-antenna networks, relay networks, and cognitive radio networks. Finally, we envision some open research directions. Recently, there has been an upsurge of research interests in radio frequency (RF) energy harvesting/scavenging technique (see and references therein), or RF harvesting in short, which is the capability of converting the received RF signals into electricity. This technique becomes a promising solution to power energy-constrained wireless networks. Conventionally, the energy-constrained wireless networks, such as wireless sensor networks, have a limited lifetime which largely confines the network performance. In contrast, an RF energy harvesting network (RF-EHN) has a sustainable power supply from a radio environment. Therefore, the RF energy harvesting capability allows the wireless devices to harvest energy from RF signals for their information processing and transmission. Consequently, RF-EHNs have found their applications quickly in various forms, such as wireless sensor networks, wireless body networks, and wireless charging systems. With the increasingly emerging applications of RF energy harvesting/charging, the Wireless Power Consortium is also making the efforts of establishing an international standard for the RF energy harvesting technique In RF energy harvesting, radio signals with frequency range from 300GHz to as low as 3kHz are used as a medium to carry energy in a form of electromagnetic radiation. RF energy transfer and harvesting is one of the wireless energy transfer techniques. The other techniques are inductive coupling and magnetic resonance coupling. Inductive coupling is based on magnetic coupling that delivers electrical energy between two coils tuned to resonate at the same frequency. The electric power is carried through the magnetic field between two coils. Magnetic resonance coupling utilizes evanescent-wave coupling to generate and transfer electrical energy between two resonators The resonator is formed by adding a capacitance on an induction coil. Both of the above two techniques are near-field wireless transmission featured with high power density and conversion efficiency. The power transmission efficiency depends on the coupling coefficient, which depends on the distance between two coils/resonators. The power strength is attenuated according to the cube of the reciprocal of the distance, specifically 60 dB per decade1 of the distance, which results in limited power transfer distance. Besides, both inductive coupling and resonance coupling require calibration and alignment of coils/resonators at transmitters and receivers. Therefore, they are not suitable for mobile and remote replenishment/charging. In contrast, RF energy transfer has no such limitation. As the radiative electromagnetic wave cannot retroact upon the antenna that generated it (by capacitive or inductive coupling) at a distance of above $\lambda/(2\pi)$ RF energy transfer can be regarded as a far-field energy transfer technique. Thus, RF energy transfer is suitable for powering a larger number of devices distributed in a wide area. The signal strength of far-field RF transmission is attenuated according to the reciprocal of the distance between transmitter and receiver, specifically, 20 dB per decade of the distance. Table I shows the comparison between the three major wireless energy transfer techniques. We can see that RF energy transfer technique has clear advantages in effective energy transfer distance. However, it has low RF-to-DC energy conversion efficiency especially when the harvested RF power is small. The readers can refer for more detailed introduction of wireless energy transfer techniques. In this article, we focus on wireless networks with the RF energy harvesting technique. Wireless power transfer has caught research attention since long ago, as a separate problem with wireless information transmission. Traditionally, free-space beaming and antennas with large apertures are used to overcome propagation loss for large power transfer. For example, in 1960's, the authors in demonstrate a small helicopter hovering at a height of 50 feet, powered by an RF source with a DC power supply of 270W operating on 2.45GHz on the ground. In the authors demonstrate a space-to-earth power transfer system using gigantic transmit antenna arrays at a satellite and receive antenna arrays at a ground station. For transmit power of 2.7GW, the power transfer efficiency is estimated to be 45% over a transfer distance of 36000km. During the past decade, with the development in RF energy harvesting circuit, low power transfer for powering mobile terminals in wireless communication systems began to attract increasing attention. The authors in propose a network architecture for RF charging stations, overlaying with an uplink cellular network. In a harvest-then-transmit protocol is introduced for power transfer in wireless broadcast system. Moreover, various modern beamforming techniques are employed to improve power transfer efficiency for mobile applications It is until recently that the dual use of RF signals for delivering energy as well as for transporting information has been advocated. Simultaneous wireless information and power transfer (SWIPT) is proposed for delivering RF energy, usually in a low power region (e.g., for sensor networks). SWIPT provides the advantage of delivering controllable and efficient on-demand wireless information and energy concurrently, which offers a low-cost option for sustainable operations of wireless systems without hardware modification on the transmitter side. However, recent research has recognized that optimizing wireless information and energy transfer simultaneously brings tradeoff on the design of a wireless system. The reason can be understood as the amount of “variations”, i.e., entropy rate, in an RF signal determines the quantity of information, while the average squared value of RF signals accounts for its power. Consequently, the amount of transmitted information and transferred energy cannot be generally maximized at the same time. This raises a demand for redesign of existing wireless networks.

LITERATURE REVIEW:

“REACH: An Efficient MAC Protocol for RF Energy Harvesting in Wireless Sensor Network”This paper proposes a MAC protocol for Radio Frequency (RF) energy harvesting in Wireless Sensor Networks (WSN). In the conventional RF energy harvesting methods, an Energy Transmitter (ET) operates in a passive manner. An ET transmits RF energy signals only when a sensor with depleted energy sends a Request-for-Energy (RFE) message. Unlike the conventional methods, an ET in the proposed scheme can actively send RF energy signals without RFE messages. An ET determines the active energy signal transmission according to the consequence of the passive energy harvesting procedures. To transmit RF energy signals without request from sensors, the ET participates in a contention-based channel access procedure. Once the ET successfully acquires the channel, it sends RF energy signals on the acquired channel during Short Charging Time (SCT). The proposed scheme determines the length of SCT to minimize the interruption of data communication. We compare the performance of the proposed protocol with RF-MAC protocol by simulation. The simulation results show that the proposed protocol can increase the energy harvesting rate by 150% with 8% loss of network throughput compared to RF-MAC. In addition, the proposed protocol can increase the lifetime of WSN because of the active energy signal transmission method. A Wireless Sensor Network (WSN) is a motive power for implementing Internet of Things (IoT) technologies and is used in many systems. As a representative example, a system has been developed that periodically monitors and manages information about a target environment (e.g., temperature, humidity, and illumination) around the sensor. There is a critical problem that the lifetime of the WSN is limited because of limited sensor batteries. Also, it cannot be assumed that all sensors are easily physically accessible. As a result, researches have been conducted to increase the energy efficiency of sensor components in order to increase the limited lifetime of the WSN. Previous works showed that the power consumption of sensors can be reduced. However, they do not consider charging the battery, so the battery will be discharged inevitably. A sensor should be able to charge itself using a specific energy source. Radio Frequency (RF) energy harvesting has been proposed as a new energy source of sensors. It supplies stable power to peripheral sensors through Energy Transmitters (ETs) without being affected by the physical environment. With these advantages, a lot of related works have been proposed for determining the routing path data aggregation method, improving the energy conversion efficiency, and duty-cycle control method. But still, there has not been enough research on the new MAC protocol considering RF energy harvesting. Current researches of the MAC protocol are only related to energy harvesting time. In a method is proposed to adjust the charging time of the sensor. The charging time is changed adaptively according to the data traffic pattern. In a method is proposed to enable for a long time charging of sensors actively involved in data communication. The charging time is determined by an Important Index (IDX) of the sensor that requests energy. Both protocols use methods to allocate the time and channel for charging or requesting energy. They inevitably delay data communication. It is difficult to guarantee real-time communication in WSN when using the existing MAC protocol. To overcome this problem, we propose a method called RF Energy Autocharging and Harvesting (REACH). When there are no packets to be transmitted in the channel, an idle time continues. In REACH, ETs automatically transmit energy to charge the sensors during the idle time. This allows sensors to maintain long data communication times. The contributions of this paper are as follows:(i)We propose REACH to charge automatically when idle time continues on the channel.(ii)An improved MAC protocol considering RF energy harvesting is proposed to prevent real-time communications from being disrupted by charging.(iii)We design

REACH that shows 150% performance improvement in harvested energy with backward compatibility.

“**RF Energy Harvesting and Transport for Wireless Sensor Network Applications: Principles and Requirements”** This paper presents an overview of principles and requirements for powering wireless sensors by radio-frequency (RF) energy harvesting or transport. The feasibility of harvesting is discussed, leading to the conclusion that RF energy transport is preferred for powering small sized sensors. These sensors are foreseen in future Smart Buildings. Transmitting in the ISM frequency bands, respecting the transmit power limits ensures that the International Commission on Non-Ionizing Radiation Protection (ICNIRP) exposure limits are not exceeded. With the transmit side limitations being explored, the propagation channel is next discussed, leading to the observation that a better than free-space attenuation may be achieved in indoors line-of-sight environments. Then, the components of the rectifying antenna (rectenna) are being discussed: rectifier, dc–dc boost converter, and antenna. The power efficiencies of all these rectenna subcomponents are being analyzed and finally some examples are shown. To make RF energy transport a feasible powering technology for low-power sensors, a number of precautions need to be taken. The propagation channel characteristics need to be taken into account by creating an appropriate transmit antenna radiation pattern All subcomponents of the rectenna need to be impedance matched, and the power transfer efficiencies of the rectifier and the boost converter need to be optimized Wireless radio-frequency (RF) energy transmission dates back to the experiments of Heinrich Hertz, in the 1880s, proving Maxwell’s theory of electromagnetics. The modern history of RF free-space power transmission may be considered to find its origin in the late 1950s with applications in microwave powered aircraft and the Solar Power Satellite Concept. After a quiet period in the 1980s and 1990s, we may observe a regained interest in the field. This interest seems to be initiated by short-range (G 2 m [5]) radio-frequency identification (RFID) applications, focusing on the available industry–science–medical (ISM) frequency bands around 0.9, 2.4, 5.8 GHz, and higher. Especially for the higher frequencies, the wavelengths become small enough for the realization of miniature wireless autonomous transducer systems (WATSs). These systems could be powered by incident RF radiation. Thereto, an antenna is connected to a rectifier to form a so-called rectenna that converts the incident RF power into usable direct current (dc) power. This dc power will, in general, pass through an energy storage system (ESS) before being delivered to the load. The schematic of a general wireless RF power transmission system is shown in Fig. 1. It should be noted that we are talking about far-field RF energy transmission, which is different from (close contact) inductive RF energy transmission or nonradiative RF energy transmission.

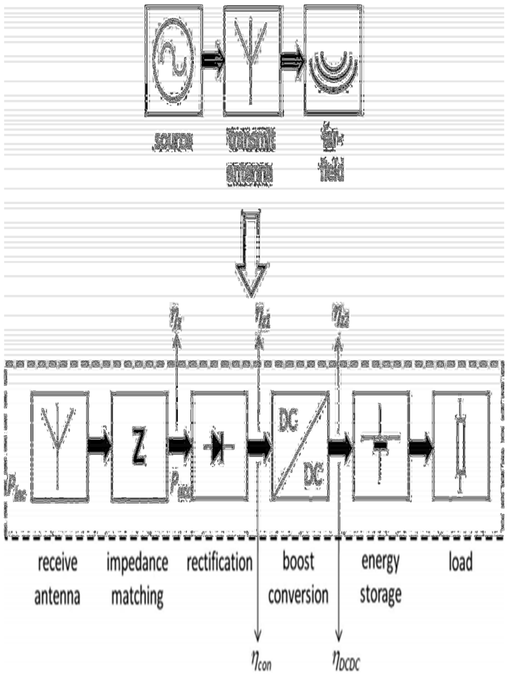


Fig : Wireless RF power system, with the rectenna in the dashed box. Pinc is the incident power upon the receive antenna; Pacc is the accepted power after impedance matching; z , z1 , and z2 are the impedance matching efficiencies; con is the rectifier power conversion efficiency; and dcdc is the boost converter power efficiency

Wireless power transport (WPT) is actively researched by groups in Finland United States], Korea Japan, Belgium, Germany, and at many other places. Considering the source in Fig. 1, we may ask if we may use ambient RF energy as a source or if we have to employ a dedicated RF source. Using the first source variant, we will refer to it as ‘‘RF energy harvesting’’; using the second variant, we will refer to it as ‘‘RF energy transport.

“WIRELESS POWERED COMMUNICATION: OPPORTUNITIES AND CHALLENGES” The performance of wireless communication is fundamentally constrained by the limited battery life of wireless devices, the operations of which are frequently disrupted due to the need of manual battery replacement/recharging. The recent advance in RF-enabled wireless energy transfer (WET) technology provides an attractive solution named wireless powered communication (WPC), where the wireless devices are powered by dedicated wireless power transmitters to provide continuous and stable microwave energy over the air. As a key enabling technology for truly perpetual communications, WPC opens up the potential to build a network with larger throughput, higher robustness, and increased flexibility compared to its battery-powered counterpart. However, the combination of wireless energy and information transmissions also raises many new research problems and implementation issues that need to be addressed. In this article, we provide an overview of stateof-the-art RF-enabled WET technologies and their applications to wireless communications, highlighting the key design challenges, solutions, and opportunities ahead Limited device battery life has always been a key consideration in the design of modern mobile wireless technologies. Frequent battery replacement/recharging is often costly due to the large number of wireless devices in use, and even infeasible in many critical applications (e.g., sensors embedded in structures and implanted medical devices). RF-enabled wireless energy transfer (WET) technology provides an attractive solution by powering wireless devices with continuous and stable energy over the air. By leveraging the far-field radiative properties of electromagnetic (EM) waves, wireless receivers could harvest energy remotely from RF signals radiated by an energy transmitter. RF-enabled WET enjoys many practical advantages, such as wide operating range, low production cost, small receiver form factor, and efficient energy multicasting thanks to the broadcast nature of EM waves. One important application of RF-enabled WET is wireless powered communication (WPC), where wireless devices use harvested RF energy to transmit/decode information to/from other devices. Without being interrupted by energy depletion due to communication usage, WPC is expected to improve user experience and convenience, with higher and more sustainable throughput performance than conventional battery-powered communication. WPC can also be applied in sensors with much lower maintenance cost and enhanced flexibility in practical deployment. Due to the high attenuation of microwave energy over distance, RF-enabled WET is commonly used for supporting lowpower devices, such as RFID tags and sensors. However, recent advances in antenna technologies and RF energy harvesting circuits have enabled much higher microwave power to be efficiently transferred and harvested by wireless devices.

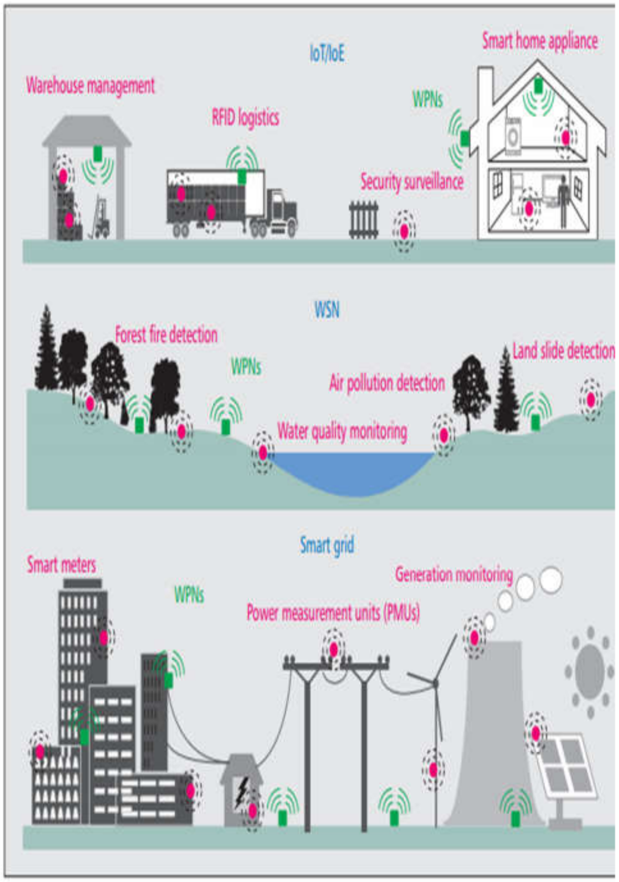


Figure Example applications of WPC in IoT/IoE systems, WSNs for environment monitoring, and smart power grid. The green nodes denote wireless power nodes (WPNs), which transmit RF energy to wireless powered devices, denoted by red nodes in the figure.

System Model and Problem Formulation

We consider a WPCN consisting of a hybrid access point (HAP), denoted by H, and a set of UNs, N = f1, 2, . . . , Ng, without fixed energy sources, as shown in Figure 1. According to the “harvest-then-transmit” protocol, the HAP provides wireless power to all the UNs in the downlink; then, all UNs use the harvested energy to transmit information to the HAP. Due to the “near-far” effect, the UNs close to the HAP obtain more energy than those far from the HAP. More importantly, these “far” UNs consume more energy to transmit information due to the poorer channel quality. Therefore, we consider multi-hop transmission to help the “far” UNs to transmit information.

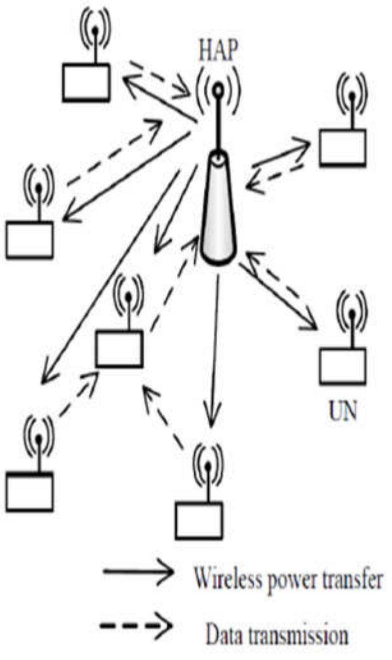


Figure 1. Model of a multi-hop wireless powered communication network.

NE-MMT Approximate Algorithm for the Max-Min Problem

In the MMT, constraint (7) contains the log function, which leads to the main difficulty in solving the problem. We use the PWL method to transform constraint (7) into a linear constraint.

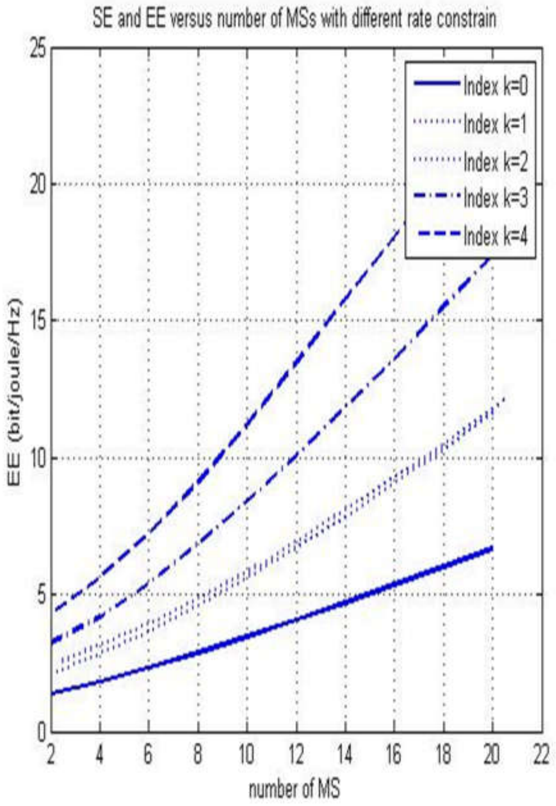
PWL Method to Transform the Nonlinear Function into a Piece-Wise Linear Function

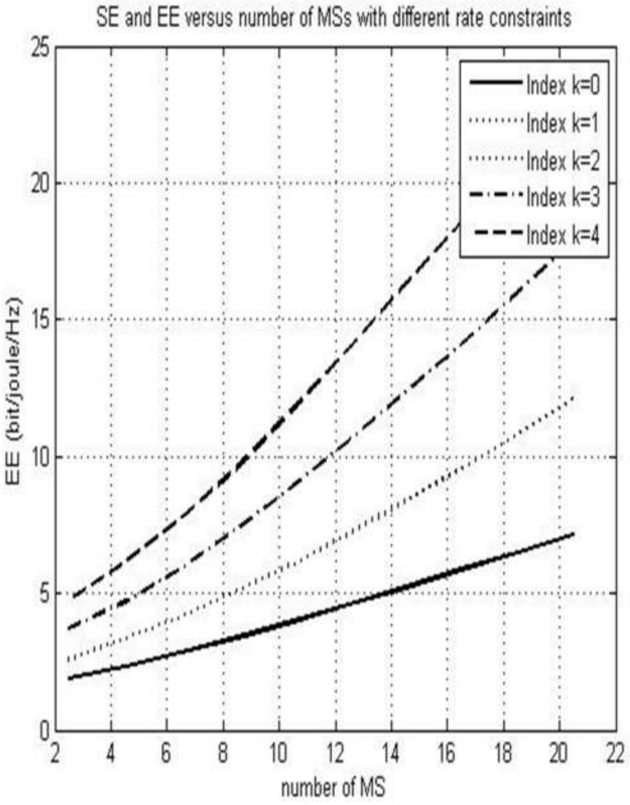
We use the proposed PWL method to linearize the log function term, as shown in Figure 2. The idea behind the PWL method is to approximate the log curve (base e) by a set of line segments and guarantee that the gap between the piece-wise function and the log function (base e), denoted as the ln function, is less than a threshold. We denote the threshold as *g*. For the sake of discussion, we use the following constraint in place of constraint (6):

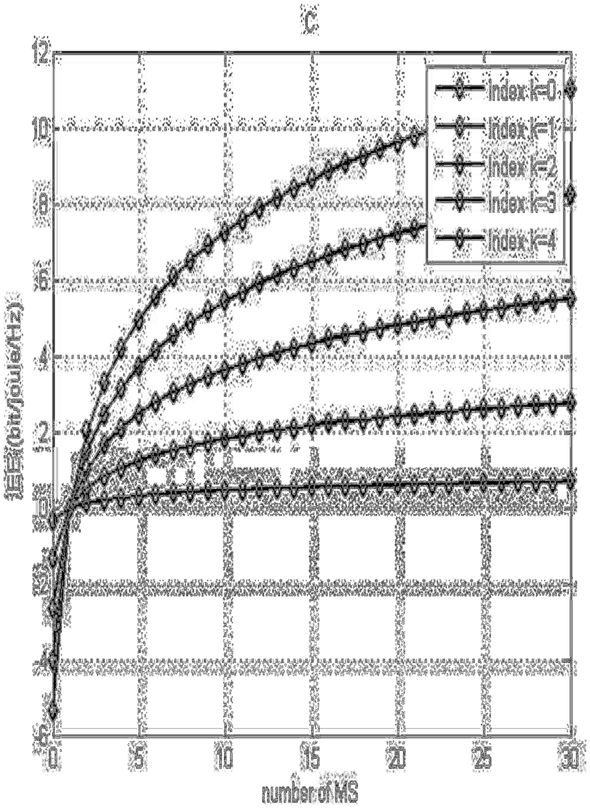
$$C_{ij} = \frac{W}{ln2} ln(1 + SNR_{ij})$$

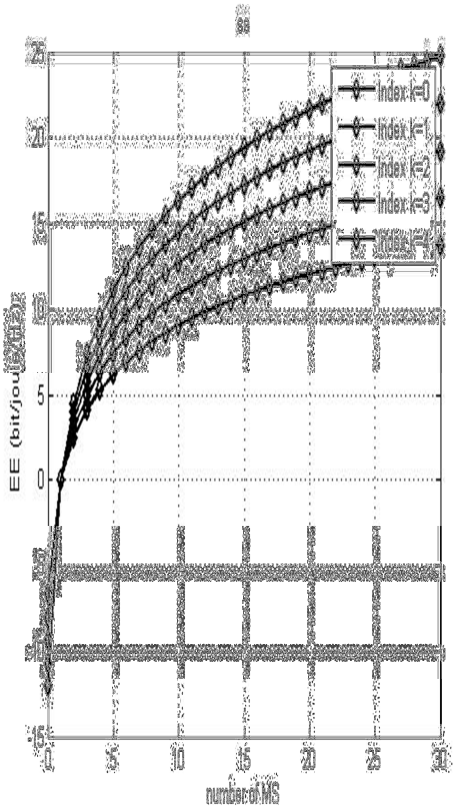
$$v_{ij}^{q} = \frac{ln\left(1 + (SNR_{ij}^{q})_{U}\right) - ln\left(1 + (SN\right.}{\left(SNR_{ij}^{q}\right)_{U} - \left(SNR_{ij}^{q}\right)_{L}}$$

SIMULATION RESULTS:









CONCLUSION:

In this paper, we proposed a user cooperation transmission method to solve the “near-far” problem in multi-hop WPCNs. Based on the method, we formulated the max-min throughput fairness problem as a mixed non-linear integer programming model. We obtained the upper and lower bounds for the optimal solution by the proposed approximate algorithm based on the piece-wise linear method and performed simulation studies to assess our algorithm. We also showed the impact of system setupsto the max-min throughput performance. From simulation results, we showed that the proposedalgorithm can obtain the compact upper and lower bounds for the problem in different system setups.Through comparison with three benchmark methods, we also showed the proposed method caneffectively enhance the throughput fairness when the transmission power of the HAP is sufficientlylarge to provide enough energy to user nodes for forwarding information. Furthermore, the proposedmethod can also effectively improve the max-min throughput performance when the amount of energyconsumption of the receiver circuitry or the path-loss exponent is small enough.

The proposed methodhas evident performance gain over the other methods.

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