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Energy Efficiency Optimization for Multiple Input Single Output Wireless Communication: A Review

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ABSTRACT
Energy efficiency (EE) has been regarded as an important metric for designing green communication systems. Also, energy harvesting technique has been recognized as a promising method which utilizes renewable energy as a meaningful energy source to support devices and improve the EE performance of wireless networks. With the advent of high-power Light Emitting Diodes (LEDs) and high-sensitivity Photo-Diodes (PD), the VLC concept appears to be especially promising in the small-cell family of the 5G era. In this paper we present the comparative review for the energy efficiency in the wireless networks, where for the multiple input single output and multiple output.

Keywords: Wireless Network, MISO, MIMO, WPCN, RF, WET.

INTRODUCTION

Energy constrained wireless networks, such as sensor networks, are usually powered by batteries and thus have limited lifetime. Wireless energy transfer (WET) via electromagnetic waves in radio frequency (RF) has appeared as a promising approach to prolong the lifetime of the energy constrained wireless networks. Various system architectures that incorporate WET into wireless information transmission (WIT) systems [1] have been proposed. Wireless powered communication network (WPCN) is one of those system architectures, where multiple users first harvest energy from the RF signal broadcasted by an access point (AP) in the downlink (DL) and then use the harvested energy to transmit data signals to the AP in the uplink (UL). Wireless energy transfer (WET), where receivers harvest energy from radio frequency (RF) signals, is considered to be a promising solution for prolonging the lifetime of wireless devices. Combined with wireless information transmission (WIT), WET introduces a paradigm shift for the design of wireless communication systems and has been studied for various system architectures.

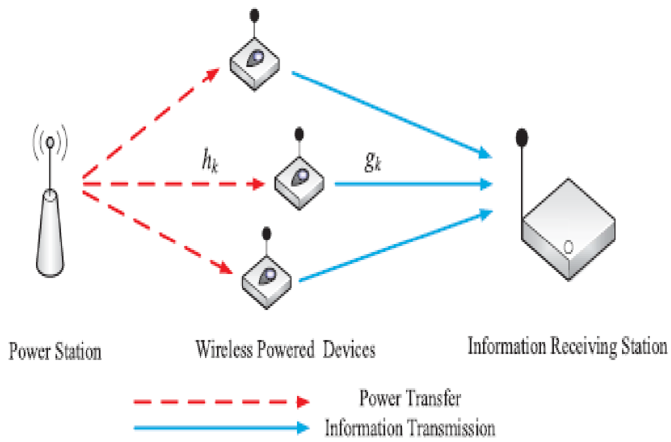

Figure 1: The system model of a wireless powered communication network (WPCN).

Wireless powered communication networks (WPCNs) have gained a lot of attentions in recent years since BSs (or power beacons) in the networks are convenient wireless power sources to replenish the power consumption of users. Most of the prior works on WPCNs were accomplished merely based on a single-cell network model. For example, the uplink throughput maximization problem with wireless power transfer constraints in the downlink was studied for a single-cell network. Since such a single-cell network model ignores the interferences from other cells, the harvested energy could be largely underestimated because the interferences from other nearby BSs could be strong energy sources to be harvested, especially when the entire network is densely deployed [10].

The rest of this paper is organized as follows in the first section we describe an introduction of about the vehicular ad-hoc network and broadcast scheme. In section II we discuss about the Smart Grid, In section III we discuss about the rich literature survey, finally in section IV we conclude the about our paper.

II SMART GRID

Smart grid technology has provided industries with a flexible solution for achieving multiple goals, such as green systems, high performance services, and scalable power offerings. The manners of communications in a Smart Grid Network (SGN) are varied and the Wireless Smart Grid Network (WSGN) is one of them. As a novel wireless technology, Cognitive Radio Networks (CRN) is an advanced wireless solution that can provide a higher level security for communications. The CRN system is programmable by which the networking system can avoid some jamming or spoofing attacks. This advantage is mainly based on the predictions of the potential threats, such that the communication can be protected by using Dynamic Spectrum Access (DSA). Therefore, traditional attack strategies can hardly block the wireless communications. WCRN is the medium that connects power sources and power users. A crucial part of the attack operations occurs at the spectrum sensing stage. This process provides adversaries with chances to intrude the system by jamming or spoofing attacks. The grey-colored circles in the figure represent the attack points when the communications connecting datacenter with IP-based infrastructure, including both power users and power plants.

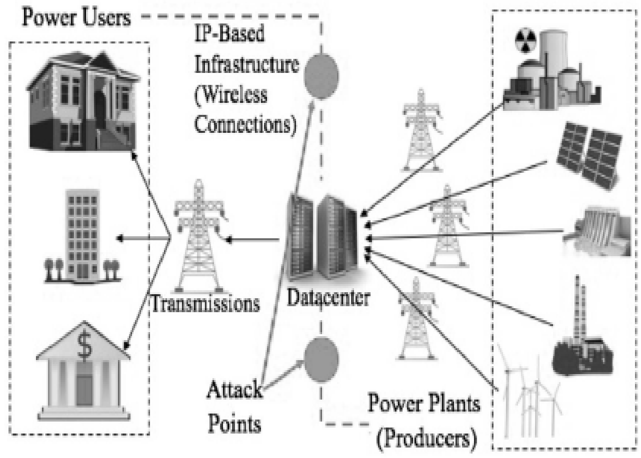

Figure 2: The structure of Maximum Attacking Strategy using Spoofing and Jamming (MAS-SJ) showing the positions of attack points.

III RELATED WORK

[1] In this paper they consider a multiple-input single-output wireless powered communication network (WPCN), where the single antenna users harvest energy from a multi-antenna access point (AP) and then transmit information back to the AP. With multiple antennas, the AP can perform energy beamforming in the downlink and exploit multiplexing- or (receive) beamforming gain in the uplink. They consider maximizing the sum of the users' energy efficiencies (EEs) by jointly optimizing the energy beamforming of the AP, transmit powers of the users, and time allocation. They formulate EE maximization problems for both TDMA-based WPCN (T-WPCN) and SDMA-based WPCN (S-WPCN), which are non-convex because they have the sum of ratios objective functions. They optimally solve the former by reformulating it into an equivalent parametric problem, whose solution can be obtained by iteratively solving convex problems, while the latter is optimally solved by convexifying it using the so called feasible set reduction scheme.

[2] In this paper, they consider wireless powered communication networks (WPCNs) where multiple users harvest energy from a dedicated

power station and then communicate with an information receiving station in a time-division manner. Thereby, our goal is to maximize the weighted sum of the user energy efficiencies (WSUEEs). In contrast to the existing system-centric approaches, the choice of the weights provides flexibility for balancing the individual user EEs via joint time allocation and power control. They first investigate the WSUEE maximization problem without the quality of service constraints. Closed-form expressions for the WSUEE as well as the optimal time allocation and power control are derived.

[3] In this paper, they study energy-efficient resource allocation in distributed antenna system with wireless power transfer, where time-division multiple access is adopted for downlink multiuser information transmission. In particular, when a user is scheduled to receive information, other users harvest energy at the same time using the same radio-frequency signal. They consider two types of energy efficiency (EE) metrics: user-centric EE (UC-EE) and network-centric EE (NC-EE). Our goal is to maximize the UC-EE and NC-EE, respectively, by optimizing the transmission time and power subject to the energy harvesting requirements of the users.

[4] In this paper they design an energy efficient indoor visible light communications (VLC) system from a radically new perspective based on an amorphous user-to-network association structure. Explicitly, this intriguing problem is approached from three inter-linked perspectives, considering the cell formation, link-level transmission and system-level optimization, critically appraising the related optical constraints. To elaborate, apart from proposing hitherto unexplored amorphous cells (A-Cells), they employ a powerful amalgam of asymmetrically clipped optical orthogonal frequency division multiplexing (ACO-OFDM) and transmitter pre-coding aided multi-input single-output (MISO) transmission.

[5] This work has developed an optimization framework to globally maximize the EE in wireless networks by jointly exploiting monotonic optimization theory and fractional programming theory. The framework is general enough to be applied to several instances of communication systems, such as general interference networks, massive MIMO systems, relay-assisted communications. While still exhibiting an exponential complexity, the developed framework enjoys a guaranteed convergence and a much lower complexity than standard global optimization algorithms.

[6] Author propose a framework to compute suboptimal power control strategies with affordable complexity. This is achieved by merging fractional programming and sequential optimization. The proposed monotonic framework is used to shed light on the ultimate performance of wireless networks in terms of EE and also to benchmark the performance of the lower-complexity framework based on sequential programming. Numerical evidence is provided to show that the sequential fractional programming framework achieves global optimality in several practical communication scenarios.

[7] In this paper they consider BS cooperation in the downlink HetNets where BSs from different tiers within the respective cooperative clusters jointly transmit the same data to a typical user, and in particular focus on the optimization of the energy efficiency performance. First, based on a proposed clustering model, they derive the spectral efficiency using tools from stochastic geometry. Furthermore, we formulate a power minimization problem with a minimum spectral efficiency constraint and derive the optimal received signal strength (RSS) thresholds under certain approximation. Building upon these results, they could address the problem of how to design appropriate RSS thresholds, taking into account the tradeoff between spectral efficiency and energy efficiency.

[8] In this paper, they investigate secure UDNs in the context of the user-centric clustering of UDNs from a secrecy energy efficiency perspective, while satisfying both the throughput and the security of each UE. They first propose a secure

user-centric clustering architecture by introducing both a dedicated jamming strategy and an embedded jamming strategy, both of which degrade the overheard signals of the eavesdroppers and guarantee secure transmission relying on the different APs' involvement status. They formulate the secure user-centric clustering design for both known and unknown eavesdropper channel state information (CSI), whilst maximizing the secrecy energy efficiency with the aid of various secure transmission schemes.

[10] This paper aims to accurately exploit the fundamental performance limits of the SWIPT between the BS and its user by modeling the cell-load impact on the downlink and uplink transmissions of each BS. They first characterize the power-splitting receiver architecture at a user and analyze the statistical properties and limits of its harvested power and energy, which reveals how much of the average energy can be harvested by users and how likely the self-powered sustainability of users can be achieved. They then derive the downlink and uplink rates that characterize the cell-load and user association effects and use them to define the energy efficiency of a user.

[11] This paper considers a wireless-powered massive multi-input multi output aided multi-way amplify-and-forward relay network, where a relay equipped with massive antennas charges users through energy beamforming and assists with wireless information transmission. For this system, they propose a novel energy efficient resource allocation scheme for the global energy efficiency (GEE) optimization. In particular, they first derive an accurate closed-form expression of GEE when zero-forcing transceivers are employed in the considered system. Second, based on this analytical expression, they formulate a resource allocation optimization problem for the GEE maximization by jointly optimizing power and time allocation, subject to limited transmit power, time duration, and minimum quality-of-service constraints.

[12] In this paper, they focus on the energy-efficient resource allocation of a cognitive multiple-input single-output NOMA system with the aid of simultaneous wireless information and power transfer. Specifically, a non-linear energy harvesting (EH) model is adopted to characterize the non-linear energy conversion property. In order to achieve the green design goal, they aim for the minimization of the system power consumption by jointly designing the transmit beamformer and the receive power splitter subject to the information transmission and EH harvesting requirements of second users (SUs), and the maximum tolerable interference constraints at primary users.

IV CONCLUSIONS AND FUTURE SCOPE

Wireless energy transfer (WET), where receivers harvest energy from radio frequency (RF) signals, is considered to be a promising solution for prolonging the lifetime of wireless devices. Combined with wireless information transmission (WIT), WET introduces a paradigm shift for the design of wireless communication systems and has been studied for various system architectures. In this article we show the literature review for the wireless communication using the multiple input and the single output scheme, for the enhancement if energy efficiency.

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