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# SCHEDULING METHODS IN D2D COMMUNICATIONS OF WSN MULTIHOP NETWORK

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*Abstract*— Wireless sensor networks are group of interconnected sensor nodes that communicate wirelessly. Each sensor node harvests energy from multiple dedicated power beacons and shares the spectrum resources with multiple primary receivers (PRs). Additionally, a practical scenario of wireless D2D communications in WSNs, where the knowledge of interference channels is assumed to be imperfect is considered. To improve the network performance, two user scheduling schemes, namely dual-hop scheduling (DHS) and best-path scheduling (BPS) schemes are proposed. The performance of multihop wireless sensor networks (WSNs) are analyzed. The performance of the proposed scheduling schemes are analyzed in terms of outage probability, delay and packet delivery factor are investigated. Through numerical results, it is shown that BPS scheme significantly outperforms DHS scheme, which in turns outperforms the state of- the-art solution.

## I. INTRODUCTION

Networking, also known as computer networking, is the practice of transporting and exchanging data between nodes over a shared medium in an information system. Networking comprises not only the design, construction and use of a network, but also the management, maintenance and operation of the network infrastructure, software and policies. Computer networking enables devices and endpoints to be connected to each other on a local area network (LAN) or to a larger network, such as the internet or a private wide area network (WAN). This is an essential function for service providers, businesses and consumers worldwide to share resources, use or offer services, and communicate. Networking facilitates everything from telephone calls to text messaging to streaming video to the internet of things (IoT). The level of skill required to operate a network directly correlates to the complexity of a given network. For example, a large enterprise may have thousands of nodes and rigorous security requirements, such as end-to-end encryption, requiring specialized network administrators to oversee the network. At the other end of the spectrum, a layperson may set up and perform basic troubleshooting for a home Wi-Fi network with a short instruction manual. Both examples constitute computer networking. There are two primary types of computer networking: wired networking and wireless networking. Wired networking requires the use of a physical medium for transportbetween nodes. Copper-based Ethernet cabling, popular due to its low cost and durability, is commonly used for digital communications in businesses and homes. Alternatively, optical fiber is used to transport data over greater distances and at faster speeds, but it has several tradeoffs, including higher costs and more fragile components. Wireless networking uses radio waves to transport data over the air, enabling devices to be connected to a network without any cabling. Wireless LANs are the most well-known and widely deployed form of wireless networking. Alternatives include microwave, satellite, cellular and Bluetooth, among others. As a general rule, wired networking offers greater speed, reliability and security compared to wireless networks; wireless networking tends to provide more flexibility, mobility and scalability. It should be noted that these types of networking concern the physical layer of the network. Networking can also

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be classified according to how it's built and designed, encompassing approaches that include software-defined networking (SDN) or overlay networks. Networking can also be categorized by environment and scale, such as LAN, campus, WAN, data center networks or storage area networks. Computer networking requires the use of physical network infrastructure -- including switches, routers and wireless access points -- and the underlying firmware that operates such equipment. Other components include the software necessary to monitor, manage and secure the network.

Additionally, networks rely on the use of standard protocols to uniformly perform discrete functions or communicate different types of data, regardless of the underlying hardware. For example, voice over IP (VoIP) can transport IP telephony traffic to any endpoint that supports the protocol. HTTP provides a common way for browsers to display webpages. The internet protocol suite, also known as TCP/IP, is a family of protocols responsible for transporting data and services over an IP-based network.

## II. REVIEW OF LITERATURE SURVEY

### *1)"MULTI-HOP D2D COMMUNICATIONS WITH NETWORK CODING:FROM A PERFORMANCE PERSPECTIVE"*

Multi-hop D2D communications play an important role in expanding D2D coverage. In this paper, we study a relaybased and network-coding-assisted (in particular, XOR coding) multi-hop D2D communication system. In the system, toward jointly considering the impact of interference and network traffic conditions on the quality of D2D communications,various channel fading models and traffic models are investigated, and the packet loss probability of D2D links is meticulously computed using these models. With packet loss probability of D2D links, the general closed-form expressions of end-to-end packet loss probability (E2EPLP) of the system with the presence (or absence) of XOR coding are subsequently derived. Our experiments reveal that both the number of relays and the mechanism of XOR coding can affect the system performance. Specifically, the increase in the number of relays will lower the overall system performance (e.g., an increase in the E2EPLP and end-to-end completion time, and a decrease of the end-to-end rate may follow as a result). On the other hand, although the presence of XOR coding unfortunately raises the system E2EPLP, it can effectively improve the end-toend completion time and end-to-end rate. It is our belief that the analytical approach proposed in this paper and the results found in our work can be useful to peer studies in the context of applying network coding in multi-hop D2D networks.

### *2)"DEVICE-TO-DEVICE COMMUNICATIONS FOR ENHANCING QUALITY OF EXPERIENCE IN SOFTWARE DEFINED MULTI-TIER LTE-A NETWORKS"*

LTE-A standard to significantly enhance the performance of cellular networks by utilizing various radio access techniques to provide ubiquitous and seamless broadband access to a rich diversity of mobile connected devices, which usually demand high QoE in spite of of access location or time. Consequently, it imposes unprecedented stringent requirements on centralized network management at the operator side, which has to overcome formidable complexity in designing, managing, and configuring network architectures, protocols, and algorithms before being able to fully support all LTE-A techniques. It is noticed that the software defined wireless network concept appears to be a promising direction to address such complexity, by decoupling control logic from all network elements and then providing fine-grained control and measurement in LTE-A networks. Toward this end, we propose in this article a device-to-device communication-based algorithm to enhance the QoE of users in software defined multi-tier LTE-A networks. Besides discussing research issues that deserve further study, we also present numerical results to illustrate the performance gains that can be achieved by applying the proposed algorithm to a typical 3GPP network scenario.

*3)"RF ENERGY HARVESTING AND TRANSFER INCOGNITIVE RADIO SENSOR NETWORK: OPPORTUNITIES AND CHALLENGE"*

By enabling sensor nodes to opportunistically access licensed channels,CRSN can provide a spectrum-efficient networking solution in the era of the Internet of Things. On the other hand, italso consumes extra energy for spectrum sensing and switching. This is a double-edged sword posing a dilemma between spectrum efficiency and energy efficiency. Recent advances in RF energy harvesting and transfer promote RF-powered CRSN in providing a promising way to address this challenge. In RF-powered CRSNs, sensor nodes can dynamically access the vacant licensed channels for interference-free data transmission and can also utilize the strong signals over the occupied licensed channels for energy harvesting. In this article, we investigate RF energy harvesting and transfer in CRSNs. We first introduce the architecture and advantages of RF-powered CRSN, typical applications, as well as the key challenges arising from applying RF energy harvesting and transfer into CRSN. We then propose a resource allocation framework to demonstrate how to jointly control the dynamic channel access and energy management to optimize network utility while guaranteeing network stability and sustainability. Some future directions are finally envisioned for furresearch.

*4)"WIRELESS ENERGY TRANSFER ENABLED D2D IN UNDER LAYING CELLULAR NETWORKS"*

Wireless powered device-to-device (D2D) communications can prolong the lifetime of energy constrained D2D transmitters. This paper proposes an analytical model for D2D communications powered by both ambient radio frequency (RF) signals from base stations (BSs) and power beacons (PBs) in a multichannel downlink cellular network to enhance harvested energy at D2D transmitters without changing the original cellular networks. With fixed transmit powers of D2D transmitters, we derive a probability for D2D transmitters to harvest enough energy for D2D communications based on stochastic geometry.We investigate the profit gained by a cellular system with RF wireless energy transfer enabled D2D (WETD2D), where the profit is defined as the difference between the revenue earned from downlink data transmission from BSs and D2D communications and the energy cost for BSs and PBs. Numerical results verify that a maximum profit of a cellular system with WET-D2D is achieved with a well-designed PB and proper transmit powers at D2D transmitters.

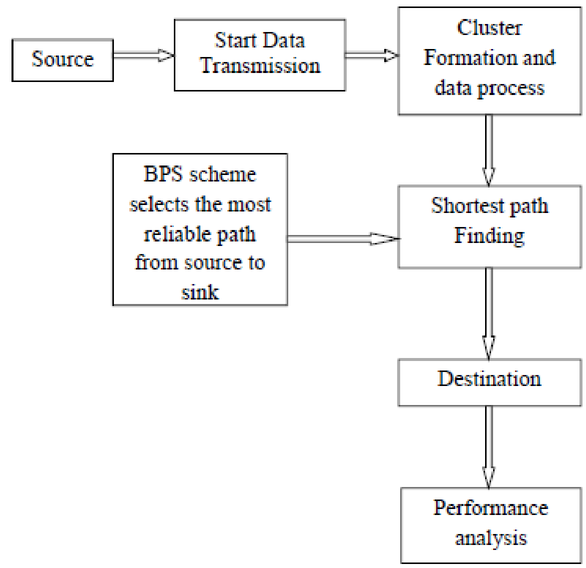
*5) "UTILITY-OPTIMAL RESOURCE MANAGEMENT AND ALLOCATION ALGORITHM FOR ENERGY HARVESTING COGNITIVE RADIO SENSOR NETWORKS"*

In this paper, we study resource management and allocation for Energy Harvesting Cognitive Radio Sensor Networks (EHCRSNs). In these networks, energy harvesting supplies the network with a continual source of energy to facilitate self-sustainability of the power-limited sensors. Furthermore, cognitive radio enables access to the underutilized licensed spectrum to mitigate the spectrum-scarcity problem in the unlicensed band. We develop an aggregate network utility optimization framework for the design of an online energy management, spectrum management and resource allocation algorithm based on Lyapunov optimization. The framework captures three stochastic processes: energy harvesting dynamics, inaccuracy of channel occupancy information, and channe fading. However, a priori knowledge of any of these processes statistics is not required. Based on the framework, we propose an online algorithm to achieve two major goals: first, balancing sensors' energy consumption and energy harvesting while stabilizing their data and energy queues; second, optimizing the utilization of the licensed spectrum while maintaining a tolerable collision rate between the licensed subscriber and unlicensed sensors. Performance analysis shows that the proposed algorithm achieves a close-to-optimal aggregate network utility while guaranteeing bounded data and energy queue occupancy. Extensive simulations are conducted to verify the effectiveness of the proposed algorithm and the impact of Various network parameter on its performance.

# III. PROPOSED SYSTEM

Consider a multi-hop WSN network with 50 nodes. Each nodes have a initial energy of 100 units and threshold of 91 units. During each data transmission, the nodes consumes 0.05 units of energy. The cluster head selection criteria is based on shortest distance with the base station, stability of the node and highest energy. Sensor nodes are distributed uniformly in a target area and remain inactive prior they detect any event in order to conserve energy. When nodes detect an event, they change inactive to active mood and select all nodes within transmission range. Node is picked as source node to transmit event to next node and finally to the base station. The algorithm transmits the event detected from source node to base station through shortest path and lowest energy BPS schemes to improve transmission and to minimize the end to-end outage probability for considered system setup. This algorithm is developed for optimal data transmission between source nodes and base station by intelligently selecting reliable and efficient path. In particular, the BPS scheme significantly outperforms DHS scheme, which in turns outperforms the benchmark scheme. The complexity analysis for each scheme is provided that allows us to design a proper scheduling strategy to achieve a good complexity-performance trade-off for specific D2D communication applications in WSNs such as search and rescue mission. The algorithm simplifies the packet structure, reducing the network energy consumption, reduces delay and packets loss.

**BLOCK DIAGRAM**




**ALGORITHM AND TECHNIQUES:**

**Step 1:** N sensor nodes uniformly in a target area.

**Step 2:** Let n1, n2, n3, ………. n be the number of sensor nodes.

**Step 3:** Initially all nodes N are inactive mode to conserve energy.

**Step 4 :** Nodes wake-up from inactive mode to active mode upon sensing changes in their environment.

**Step 5:** Each data sensed by a node is assigned a unique number id and broadcast it to all nodes in the network.

**Step 6:** Each node that receives the id checks if it is already store in its memory

If yes, the data will be discarded. It shows the data has been sensed and forwarded by other nodes.

Else

**Step 7:** A node n, selects M nodes where M is set of all nodes within its transmission range R End if.

**Step 8:** Select node n, with shortest distance to the base station.

**Step 9:** Check whether the current energy of n> Ave. energy of M .if yes, sends

data Else go to step 7

**Step 10:** Check whether the data has reached the base station.

If yes, broadcast the data id to all nodes (to prevent other nodes send similar data through other paths)

Else go to step 4

End

# IV. CONCLUSION

A user scheduling schemes to improve the outage performance for multi-hop cognitive wireless powered transfer D2D communications in WSNs is developed. Particularly, the exact closed-form expressions for the OP of benchmark, DHS and BPS schemes is derived. The outage performance results were also analyzed under two limiting cases such as interference-tolerant and interference-limited, which are shown in simplified forms suitable for network planing and designing. The numerical results showed that for the same channel setting, the BPS scheme provided the best performance. Moreover, the inaccurate CSI estimation of interference links affects significantly any aspect of multi-hop D2D network in terms of outage probability, outage floor and performance loss are showed. In addition, the optimal pair of K could be obtained by using numerical results. As aresult, the proposed schemes are indeed promising for future wireless sensor networks to enhance the system performance and extend the network.

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