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Energy-Efficient Transmission in Heterogeneous Wireless Networks: A Delay-Aware Approach

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ABSTRACT- In this paper we investigate the delay-aware energy efficient transmission problem in dynamic heterogeneous wireless networks (HWNs) with time-variant channel conditions, random traffic loads, and user mobility. By jointly considering subcarrier assignment, power allocation, and time fraction determination, we formulate it as a stochastic optimization problem to maximize the system energy efficiency (EE) and to ensure network stability. By leveraging the fractional programming theory and the Lyapunov optimization technique, we first propose a general algorithm framework, referred to as the eTrans, to solve the formulation. Further, we exploit the special structure of the subproblem embedded in the eTrans to develop the extremely simple and low complexity but optimal algorithms for subcarrier assignment, power allocation, and time fraction determination. In particular, all of them have closed-form solutions, and no iteration is required, which paves the way for employing the eTrans to practical applications. The theoretical analysis and simulation results exhibit that eTrans can flexibly strike a balance between EE and average delay by simply tuning an introduced control parameter

I. INTRODUCTION

In mission-critical applications, such as battlefield reconnaissance, fire detection in forests, and gas monitoring in coal mines, wireless sensor networks (WSNs) are deployed in a wide range of areas, with a huge number of sensor nodes reporting and detecting some information of importunateness to the end-users. As there may be no communication framework, users are usually provided with communicating devices to communicate with sensor nodes. An alarm needs to be broadcast to the other nodes as soon as possible when a unfavourable event (e.g., fire or gas leak) occurs in the monitoring area and is detected by a sensor node. Then, sensor nodes can warn users nearby take some response to the event or to flee.

The current networks are bi-directional, also authorizing control of sensor activity. The development of wireless sensor networks was inspired by military applications like battlefield surveillance; today such networks are used in many consumer applications and industries, such as machine health monitoring, industrial process monitoring and control and, so on. The WSN is built of "nodes" – from not many to hundreds or even thousands, where every node is connected to one (or sometimes several) sensors. Such sensor network node has typically many parts: connection to an external antenna or a radio transceiver with an internal antenna , an electronic circuit for interfacing with the sensors and an energy source, a microcontroller, usually a battery or an embedded form of energy harvesting. The price of sensor nodes is comparably variable, ranging from a few to hundreds of dollars, depending on the convolution of the individual sensor nodes. Price and size constraints on sensor nodes result in corresponding constraints on resources such as memory, energy, speed, computational and communications bandwidth. The topology of the WSNs can differ from a advanced multi-hop wireless mesh network to a simple star network . In telecommunications and computer science wireless sensor networks are an active research area with numerous workshops and conferences scheduled every year.

The modern advances in micro electro mechanical systems and distributed computing have sanctioned in the past few years the emergence of a variety of wireless sensor network applications comprising military, building, disaster management, environment, health, industry and domains. Wireless sensor network is a network of spatially distributed sensor nodes equipped with sensing, power, computing and communication modules to monitor a certain phenomenon such as object or environmental data tracking. The nodes in such networks are characterized by memory resources minimal power and processing. As the sensor nodes are powered by batteries, it is recharge these batteries or tough to replace because of cost (e.g., labor and cost of batteries) or geographic (e.g., unfriendly terrain or difficult) reasons.

A sensor node consumes battery power in the following four operations: receiving data, sensing data, processing data and sending data. Generally, RF module is the most energy consuming component that provides wireless communications. As a result, out of all the sensor node operations, receiving/sending data consumes more energy than any other operations. The energy depletion for transmitting 1 bit of data on the wireless channel is equivalent to the energy needed to execute thousands of cycles of CPU instructions. Therefore, the network lifetime extends due to the efficient use of energy in WSN communication protocols. Hence, any network, MAC and transport layer protocols designed for WSN should give due consideration to the efficient use of RF module by decreasing MAC collision, efficient sleep/wake scheduling, control message overhead in routing and so on. In addition, during protocol design the limited resources of sensor nodes should also be considered, which includes less memory, low processing power, low sensing power and short-range communication.

As sensor nodes for event monitoring are expected to work for a long period without recharging their batteries, during the monitoring process sleep scheduling method is always used. Evidently, sleep scheduling could cause transmission retard because until receiver nodes are active the sender nodes should wait and ready to receive the message. The retard could be significant as the network scale rises. Most of sleep scheduling method focus on decreasing the energy depletion. Actually, in the critical event monitoring, most of the time only a minimum number of packets need to be transmitted . When a censorious event is exposed, the alarm packet should be broadcast to the entire network as soon as possible. Hence, broadcasting delay is an important issue for the application of the censorious event monitoring. The ideal scenario is the destination nodes wakeup suddenly when the source nodes obtain the broadcasting packets.

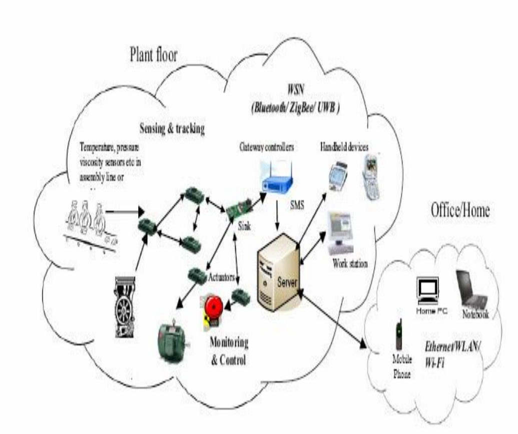

Fig.1.WSN Industrial Applications

Distributed Intelligent Sensing System for
- ✓ Factory automation
- ✓ Process Control
- ✓ Real-time monitoring of machinery's health
- ✓ Detection of liquid/gas leakage
- ✓ Remote monitoring of contaminated areas

1. Near-optimal online algorithm for data collection by multiple sinks in wireless sensor networks

Mobility and static based sink placement schemes are used to handle data collection process. Mobile sinks are used to maximize the network lifetime with retard constraints. Random mobility and controlled mobility models are used in the mobile sinks. The sinks are moved randomly within the network in random mobility. The sinks are deterministically moved across the network is known as controlled mobility. The network lifetime is controlled with the delay values and number of nodes. The Delay bounded Sink Mobility (DeSM) problem is instigate under sensor node issuance to sinks. For the origin problem a polynomial-time optimal algorithm is used. To schedule sink nodes Extended Sink Scheduling Data Routing (E-SSDR) algorithm is used.

2. A trust-based adaptive probability marking and storage trace back scheme for WSNs

Security is a crucial matter for wireless sensor networks (WSNs), which are emerging as a promising platform that allows a wide range of military, industrial, commercial applications and scientific. Trace back, a key cyber-forensics technology, can play an significant role in locating and tracing a spiteful source to guarantee cyber security. In this work a trust-based adaptive probability storage and marking (TAPMS) trace back scheme is proposed to strengthen security for WSNs. In a TAPMS scheme, the marking probability is adaptively adjusted according to the security requirements of the network and can substantially decrease the number of marking tuples and enhance network lifetime. Especially, a high trust node is chosen to store marking tuples, which can refrain from the problem of marking information being lost.

3. Multi-channel assignment in wireless sensor networks: A game theoretic approach

We then suggest a distributed Game Based Channel Assignment algorithm (GBCA) to resolve the problem. The GBCA takes into account both the transmission routing information and the network topology information. We prove there exists at least one Nash Equilibrium in the channel assignment game. Additionally, we study the sub-optimality of Nash Equilibrium and the convergence of the best Response in the game. Simulation results show that GBCA can minimize the interference significantly and achieve satisfactory network performance in terms of throughput, packet transfer delay, delivery ratio and energy consumption.

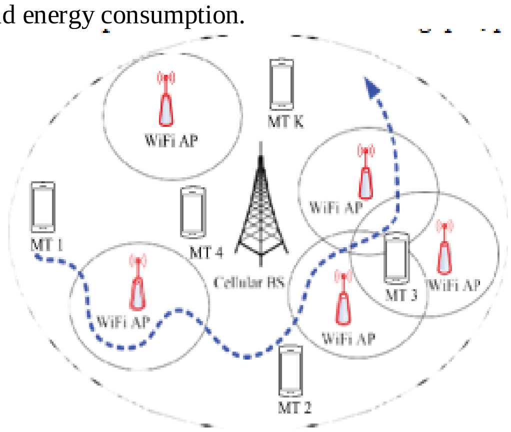

Illustration scenario of HWNs

The HWNs, as shown in the above image, are composed of the cellular network(CN) andWi-Fi,[1]whereusersmove.It is one of the most popular integration scenarios in HWNs and is advocated by Qualcomm as an efficient network architecture to solve the future 1000data challenge[6]. In this paper, we consider orthogonal frequency-division multiple access (OFDMA)-based cellular systems, e.g., the3GPP LTE and WiMAX, and assume that the BS and each access point (AP) work on non-overlapping channels; thus, there is no interference among the BS and APs.

II. SYSTEM MODULE

A. Wireless Sensor Network Formation

Wireless sensor network is a collection of several wireless sensors, each of which monitors define environmental attributes, derives environmental conditions by aggregating the sensing data, records sensing data and returns the aggregated data to the base station. The swift development of embedded micro-sensing technologies and wireless communications enabled the use of wireless sensor networks in our daily lives.

B. Data Collection and Secure Aggregation

This Module is generated to WSN networks data communication and aggregation process. The IEEE 802.11 MAC layer models and radio were used. The network based data processing are overpriced and data communication level on their performance on the network. Multiple sources create and stops sending packets; every single data has a steady size of 512 bytes. Each Sensor node to move randomly on their network, it's most anticipatable on their networks.

C. Trust Computation

This module is developed to trust for every node is directly measured by their immediate neighbours and kept updated at regular intervals in the trust table. The existing trust table is cultivated to all other nodes as 'recommendation' part of the trust.

D. TSEOAP

Novel energy-aware routing algorithms to be proposed for Wireless Sensor networks, called reliable minimum Trust Secure Energy optimized Aggregation Protocol (TSEOAP). TSEOAP addresses important requirements of WSN: energy-efficiency, reliability, Data Aggregation and attacker's detection (sinkhole, wormhole, blackhole).

E. Performance Analysis Result

This module is generated to improve Wireless Sensor network performance, Reduce Average end –to-end delay.

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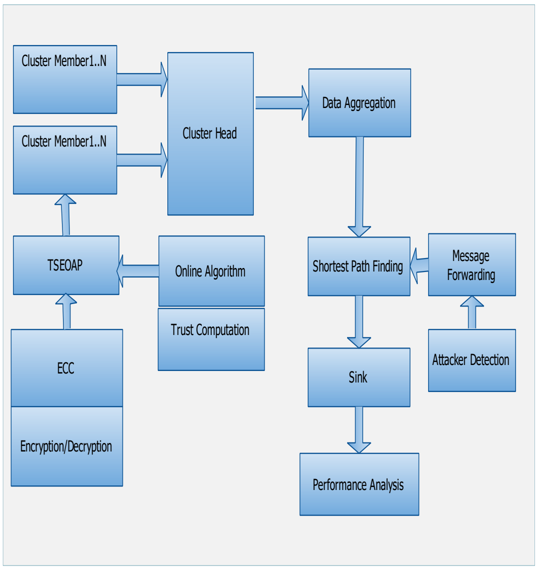


III. CLUSTERING AND ROUTING STRATEGY

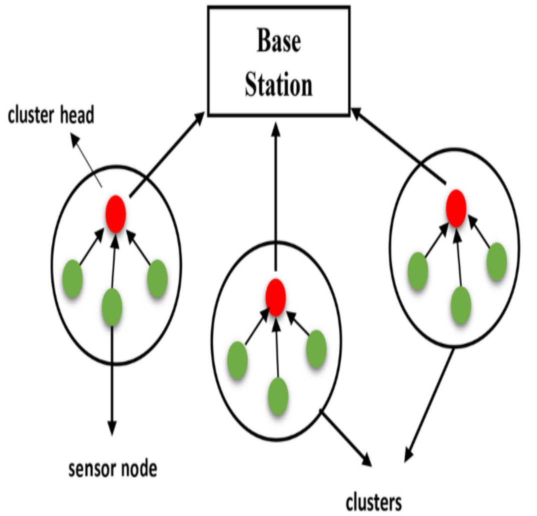
Modeling of a Smart City Environment

It is overpriced to design and test newly developed protocols on a real WSN with the preferred amount of nodes (probably high); as a result, a bulk of protocol improvement research used a simulation approach and modeling; sometimes using an emulator for affirmation purposes. Hence, the proposed WSN protocols were analyzed and tested using simulation-based testing tools, namely Ptolemy-II Visual sense for modeling and Mannasim framework for simulation.

This study, which is part of the operational analysis and CRS design, uses a preferred network and power model to regulate the behavior of the WSN for smart environs. There-fore, the preferred simulation tools are made to employ most of the network characteristics and power dissipation estimates from the standard LEACH routing protocol.

Network Set-Up

To study the plot in this research, we are as summing a deployed WSN that contains all of the sensor nodes of various services, $X=S^1|S^2|...S^N$randomly spread in a coverage region (presumed smart area).Essential datasinks or BS a real so considered in the sensing area. After the installation of all sensing nodes and the required BS,they are expected to be immobile. On top of that, we classify the heterogeneity of the sensor nodes based on their services in as mart environment. They are periodic(P), regular(R), and emergency(E) services, which means they do not have same abilities, such as processing, reception/transmission range, energy capability and so on. By improving energy utilization, sensor nodes may employ power management to control the data transmission power level that depends entirely on the receiver's distance. Wireless connections are preferred for all communications. Communication is official among various deployed nodes only if the interested nodes are within the reachable, communicative range of others. In this model, because the transmitting power is predefined, each node can decide the distance of its neighbors based on the Minkowskimetrics.



Architecture of Clustering and Routing Protocol

IV. CONCLUSION

In this paper, we have formulated a random optimization problem to investigate the **Energy-Efficient Transmission in Heterogeneous Wireless Networks (HWNs)** by jointly optimizing subcarrier assignment, power allocation and time fraction determination. Resorting to the fractional programming theory and the Lyapunov optimization technique, we have devised the e-Trans to solve the problem. Most importantly, we have developed the extremely simple and optimal algorithms for subcarrier assignment, power allocation, and time fraction determination with low complexity, where all of them have the closed-form solutions without requiring any iteration. The theoretical analysis and simulation results have verified the capability of thee-Transt of lexibly control EE and average delay.

REFERENCES

[1]. Y. Chen, S. Zhang, S. Xu, and G. Li, “Fundamental trade-offs on

greenwirelessnetworks,"IEEECommun.Mag.,vol.49,no.6,pp.30–37,Jun.2011.
[2]. J. Rao and A. Fapojuwo, "A survey of energy efficient resource manage-menttechniquesformulticellcellularnetworks,"IEEECommun.SurveysTuts.,vol.16, no. 1,pp. 154–180,1stQuart.2014.
[3]. C.-X.Wangetal.,"Cellulararchitectureandkeytechnologiesfor5G wireless communication networks," IEEE Commun. Mag., vol. 52,no. 2,pp. 122–130,Feb. 2014.
[4]. L. Wang and G.-S. Kuo, "Mathematical modeling for network selectionin heterogeneous wireless networks–A tutorial," IEEE Commun. SurveysTuts., vol.15, no. 1,pp. 271–292, Jan. 2013.
[5]. A.Ahmed, L. Boulahia, and D. Gaïti, "Enabling vertical handover deci-sions in heterogeneous wireless networks: A state-of-the-art and a clas-sification," IEEE Commun. Surveys Tuts., vol. 16, no. 2, pp. 776–811,2ndQuart.2014.
[6]. "The1000datachallenge,"Qualcomm,SanDiego,CA,USA.[Online].Available:http://www.qualcomm.com/solutions/wireless-networks/technologies/1000x-data
[7]. M.IsmailandW.Zhuang,"Adistributedmulti-service resourceallocationalgorithm in heterogeneous wireless access medium," IEEE J. Sel. AreasCommun.,vol.30, no. 2,pp. 425–432, Feb. 2012.
[8]. X.Pei,T.Jiang,D.Qu,G.Zhu,andJ.Liu,"Radio-resourcemanagementand access-control mechanism based on a novel economic model in het-erogeneouswirelessnetworks,"IEEETrans. Veh.Technol.,vol.59,no.6,pp. 3047–3056,Jul.2010.
[9]. E. Aryafar, A. Keshavarz-Haddad,M. Wang, and M. Chiang, "RATselection games in HetNets," in Proc. IEEE INFOCOM, Turin, Italy,Apr. 2013,pp.998–1006.
[10]. Y. Choi, H. Kim, S. W. Han, and Y. Han, "Joint resource allocation forparallel multi-radio access in heterogeneous wireless networks," IEEETrans.Wireless Commun.,vol.9,no.11,pp.3324–3329,Nov.2010.
[11]. P.Xue,P.Gong,J.H.Park,D.Park,andD.K.Kim,"Radioresourceman-agementwithproportionalrateconstraintintheheterogeneous networks,"IEEETrans.WirelessCommun.,vol.11,no.3,pp.1066–1075,Mar.2012.
[12]. M. Ismail, W. Zhuang, and S. Elhedhli, "Energy and content aware multi-homing video transmission in heterogeneous networks," IEEE Trans.Wireless Commun.,vol.12,no.7,pp.3600–3610,Jul.2013.
[13]. M.-R.Raetal.,"Energy-delaytradeoffsinsmartphoneapplications,"in
[14]. Proc.MobiSys,NewYork,NY,USA,Jun.2010,pp.255–270.
[15]. P. Shu et al., "eTime: Energy-efficient transmission between cloud andmobiledevices,"inProc.IEEEINFOCOM,Turin,Italy,Apr.2013,pp. 14–1