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Rethinking Mobile Data Offloading to Combine Wi-Fi andSmall Cell in Unlicensed Spectrum

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ABSTRACT

Traditional mobile data offloading transfers cellular users to Wi-Fi networks to relieve the cellular system from the pressure of the ever-increasing data traffic load. The spectrum utilization of the Wi-Fi network is bound to suffer from potential packet collisions due to its contention-based access protocol, especially when the number of competing Wi-Fi users grows large. To tackle this problem, proposing to transfer some Wi-Fi users to be served by the LTE system, in contrast to the traditional mobile data offloading which effectively offloads LTE traffic to the Wi-Fi network. We investigate three different user transfer schemes according to the availability of channel state information (CSI): The random transfer, the distance-based transfer, and the CSI-based transfer. In each scheme, the minimum required amount of unlicensedresources under a given transferred user number is analyzed. Furthermore, we utilize the Nash bargaining solution(NBS) to develop joint user transfer and unlicensed resource allocation strategy to fulfill the win-win situation for both networks, whose performance is demonstrated by numerical simulation.

KEYWORDS--Mobile Offloading,LTE, Nash bargaining solution, win-win situation.

I.INTRODUCTION

Wireless Sensor Network (WSN) is a self-organized network of tiny computing and a communication device (nodes) has been widely used in several un-attended and dangerous environments. In a typical deployment of WSN, nodes are battery operated where they cooperatively monitor and report some phenomenon of interest to a central node called sink or base-station for further processing and analysis. Traditional static nodes deployment where nodes exhibit n-to-1 communication in reporting their observed data to a single static sink, gives rise to energy-hole phenomenon in the vicinity of sink. Sink mobility introduced in not only helps to balance the nodes' energy dissipation but can also link isolated network segments in problematic areas. In addition, several application environments naturally require sink mobility in the sensor field e.g., in a disaster management system, a rescuer equipped with a PDA can move around the disaster area to look for any survivor. Similarly, in a battlefield environment, a commander can obtain real-time information about any intrusion of enemies, scale of attack, suspicious activities etc via field sensors while on the move. In an Intelligent Transport System (ITS), sensor nodes deployed at various points of interest - junctions, car parks, areas susceptible to falling rocks, can provide early warnings to drivers (mobile sink) well ahead of their physical approach. The idea of integrating Wi-Fi and small cells holds the promise of helping operators solve the capacity crunch problem exacerbated by network densification. Indeed, Wi-Fi technology has limits that small cells can capitalize on, such as in cases of high traffic congestion and load, in which a large number of Wi-Fi users compete in shared but uncontrolled spectrum, yielding dramatically poor throughputs. In contrast, a better managed small cell operation transmitting over licensed spectrum yields better performance gains.

II. RELATED WORKS

2.1 Efficient routing in carrier-based mobile networks

The past years have seen an intense research effort directed at study of delay/disruption tolerant networks and related concepts (intermittently connected networks, opportunistic mobility networks). While multiple network models have been proposed and routing in them investigated. In this paper, we propose a simple model of opportunistic mobility network based on oblivious carriers, and investigate the routing problem in such networks. We present an optimal online routing algorithm and compare it with a simple shortest-path inspired routing and optimal offline routing. In doing so, we identify the key parameters (the minimum non-zero probability of meeting among the carrier pairs, and the number of carriers a given carrier comes into contact) driving the separation among these algorithms.

2.2 Energy conservation in wireless sensor network

In the last years, wireless sensor networks (WSNs) have gained increasing attention from both the research community and actual users. As sensor nodes are generally battery-powered devices, the critical aspects to face concern how to reduce the energy consumption of nodes, so that the network lifetime can be extended to reasonable times. In this paper we first break down the energy consumption for the components of a typical sensor node, and discuss the main directions to energy conservation in WSNs. Special attention has been devoted to promising solutions which have not yet obtained a wide attention in the literature, such as techniques for energy efficient data acquisition. Finally we conclude the paper with insights for research directions about energy conservation in WSNs.

While multiple network models have been proposed and routing in them investigated, most of the published results are of heuristic nature with experimental validation; analytical results are scarce and apply mostly to networks whose structure follows deterministic schedule. As sensor nodes are generally battery-powered devices, the critical aspects to face concern how to reduce the energy consumption of nodes, so that the network lifetime can be extended to reasonable times. In this paper we first break down the energy consumption for the components of a typical sensor node, and discuss the main directions to energy conservation in WSNs. Contrary to traditional WSNs where sensory data from sensor field is ultimately sent to a static sink, mobile sink-based approaches alleviate energy-holes issues thereby facilitating balanced energy consumption among nodes. In mobility scenarios, nodes need to keep track of the latest location of mobile sinks for data delivery. Wireless sensor networks (WSNs) have emerged as an effective solution for a wide range of applications. Most of the traditional WSN architectures consist of static nodes which are densely deployed over a sensing area.

2.3 Data Collection in Wireless Sensor Networks with Mobile Elements

Wireless sensor networks (WSNs) have emerged as an effective solution for a wide range of applications. Most of the traditional WSN architectures consist of static nodes which are densely deployed over a sensing area. Recently, several WSN architectures based on mobile elements (MEs) have been proposed. Most of them exploit mobility to address the problem of data collection in WSNs. In this paper we first define WSNs with MEs and provide a comprehensive taxonomy of their architectures, based on the role of the MEs. Then, we present an overview of the datacollection process in such scenario, and identify the corresponding issues and challenges. On the basis of these issues, we provide an extensive survey of the related literature. Finally, we compare the underlying approaches and solutions, with hints to open problems. A logically centralized optimization frame-work has been developed for Wi-Fi and LTE coexistence, which involves dynamic spectrum management and inter-network coordination. In, optimal resource allocation algorithms for both dual-band femtocell systems and integrated femto-WiFi networks have been developed. Joint licensed and unlicensed resource allocation algorithms for LAA systems have been developed in and for throughput and energy efficiency maximization, respectively. In, we have compared the performance of traffic offloading and LTE-U in terms of large-scale system throughput and developed a novel mechanism to exploit the advantages of both traffic offloading and LTE-U.

The traditional proposed algorithm is a centralized one and should be realized by an inter-operator coordinator, which is potentially expensive or complicated. In practical systems, distributed implementation without the help of inter-operator coordinator is of great significance, which can be left as our future work. Moreover, some simplified models for the Wi-Fi network have also been used. In the future, one can consider a more practical Wi-Fi model taking into account the non-saturation traffic, adaptive modulation and coding, hidden and exposed node problem, etc. To meet this challenge, mobile network operators have deployed many small cell base stations SBSs) and Wi-Fi access points (APs) to offload the cellular traffic, which is referred to as mobile data offloading. Due to its low cost and license-exemption, the deployment of Wi-Fi AP scan remarkably increase the network capacity without incurring too much operational and capital expenditures. Therefore, the vast majority of recent research is focusing on offloading cellular traffic to the Wi-Fi network. Nowadays, a large number of Wi-Fi devices (e.g., smartphones) are also equipped with cellular capabilities and this number will keep increasing in the future.

III. Mobile Data Offloading

In proposed system to access the data without data traffic, the traffic steering solution is validated in a Long-Term Evolution (LTE) simulator augmented with Wi-Fi hotspots. And also we propose a self-organizing traffic offloading procedure, through which small cells (seamlessly) steer their traffic between 3G and Wi-Fi radio access technologies (RATs), as a function of (heterogeneous) users' traffic requirements, network load, and interference levels. To cope with peak data traffic demands, operators are compelled to find new ways to boost their network capacity, provide better coverage, and ease network congestion.The idea of integrating Wi-Fi and small cells holds the promise of helping operators solve the capacity crunch problem exacerbated by network densification.The distributed regret-based learning algorithm for joint interference and traffic offloading formally described. The proposed traffic-aware scheduling algorithm incorporates users' traffic requirements the scheduling decision is not only based on the instantaneous channel condition, but also on the completion time (delay), and service class.

Fig.1 SYSTEM ARCHITECTURE

Here we propose distributed traffic steering algorithm which gradually reduce the cost of both base station to pareto optimum proportionally. This leads to better performance & quality than the existing system. By using this algorithm the data traffic will also reduce and it helps to transfer data

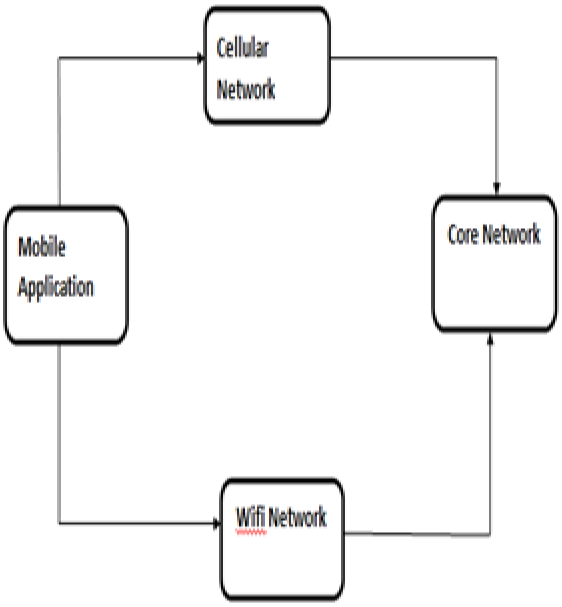

Figure 1: Block diagram

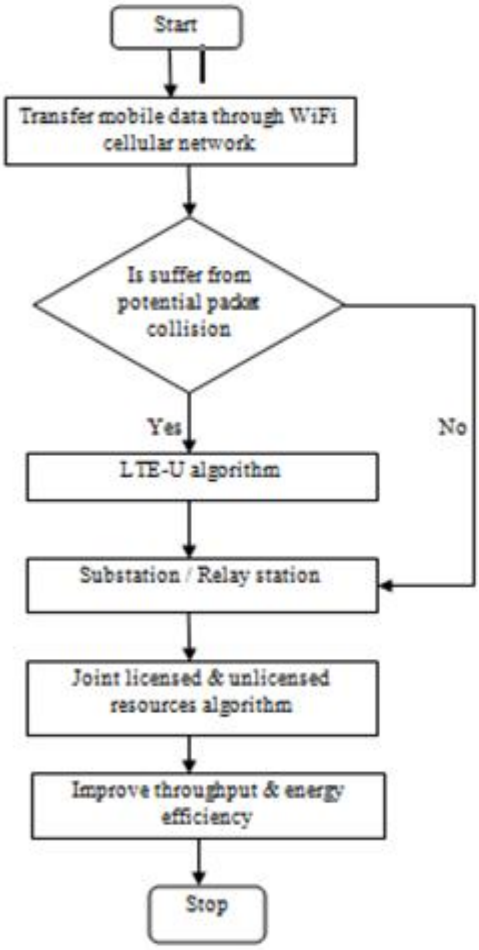

Fig. 2 Flow Chart

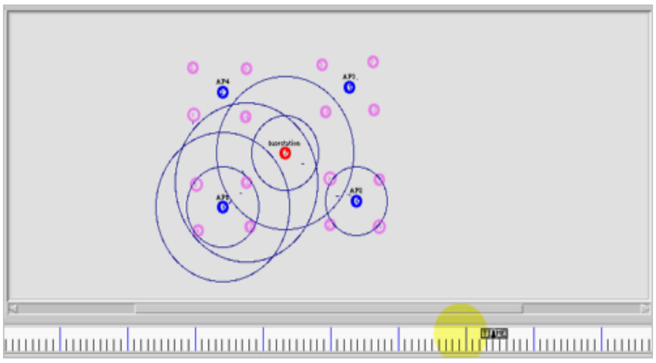

Fig. 3 Minimum amount of data transfer

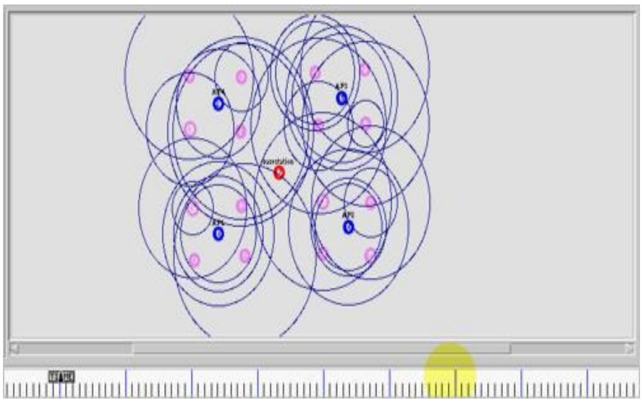

Fig .4 Maximum amount of data transfer

IV CONCLUSION

In this paper, we have revisited mobile offloading in LTE and Wi-Fi coexistence network in the new framework of LTE-U. Subversively, we propose to transfer Wi-Fi users and relinquish some unlicensed resources to the LTE-U network at the same time. A win-win strategy for both the LTE and the Wi-Fi systems has been demonstrated. We have also utilized the NBS to design a joint user transfer and unlicensed resource allocation algorithm. Through numerical simulation, we have compared the three different user transfer schemes based on the availability of CSI and in all three schemes, a win-win situation for both networks can be observed. Moreover, some simplified models for the Wi-Fi network have also been used. However,the main idea of this paper to avoid data Traffic.

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