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Efficient Fair Scheduling in OFDMA Network

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Abstract: A system based on orthogonal frequency division multiple access (OFDMA) has been developed to deliver mobile broadband data service at data rates comparable to those of wired services, such as DSL and cable modems. When flows pass through relay stations in OFDMA network, plenty of network coding opportunities arise and leveraged to enhance throughput. Here, the proportional-fair scheduling problem in the presence of network coding in OFDMA relay networks is studied. The proposed approach uses heuristic algorithm and greedy algorithm to solve the problem. As a result, it improves the network throughput and time complexity. This paper compares simplicity, fairness and efficiency of our algorithm with the optimal and proposed suboptimal algorithms for network throughput and time complexity. The results show that performance of our approach is appealing and can be close to optimal. Further, it is compared with the TPO scheduling.

Keywords: heuristic; OFDMA; throughput; complexity

I. INTRODUCTION

Orthogonal Frequency Division Multiple Access (OFDMA) is a promising multiple access scheme that has attracted interest. OFDMA is based on OFDM and inherits its immunity to inter-symbol interference and frequency selective fading. Orthogonal frequency division multiplexing (OFDM) has become the popular choice for air interface technology in future local and wide area wireless networks. The entire spectrum is divided into multiple carriers (sub-channels), leading to several physical layer and scheduling benefits. The two-hop network model coupled with OFDM provides two key benefits, namely diversity and spatial reuse gains. Three kinds of diversity gains can be exploited through scheduling: (i) multi-user diversity: for a given sub-channel, different users experience different fading statistics, allowing us to pick a user with a larger gain; (ii) channel diversity: sub-channels experiencing high gain could vary from one user to another, allowing for multiple users to be assigned their best channels in tandem; and (iii) cooperative diversity: relays can exploit wireless broadcast advantage to cooperate and improve the SNR (signal-noise ratio) at the intended receiver. In addition to the diversity gain, the two-hop network model also provides room for spatial reuse, whereby simultaneous transmissions on the relay hop (BS-RS) and access hop (RS-MS) can be leveraged on the same channel as long as there is no mutual interference. User and channel diversity gains, available in conventional one hop cellular networks, have been effectively leveraged to improve system performance through several channel-dependent scheduling schemes. However, they do not provide spatial reuse or cooperative diversity gains. MWNs on the other hand, provide spatial reuse. However, since diversity gains require channel state feedback from RS and MS and must be exploited at fine time scales (order of frames), they cannot be effectively leveraged in a large multi-hop setting. Relay-enabled networks with a two-hop structure provide a unique middle-ground between these two networks, providing us access to a multitude of diversity and spatial reuse gains. While this provides potential for significant performance improvement, it also calls for more sophisticated, tailored scheduling solutions that take into account the two-hop nature of the system.

The emerging generation of wireless standards such as 802.16 have identified OFDMA (Orthogonal Frequency Division Multiple Access) as a promising technology enabling broadband wireless access. In OFDMA systems, the prescribed frequency band is divided into hundreds of orthogonal subbands called subcarriers. The base station (BS) assigns disjunctive sets of subcarriers to mobile stations (MS) which multiplex the available downlink capacity. In the original 802.16 PHY specification, subcarriers are either statically or randomly allocated to the MSs, oblivious of their diverse channel conditions. In reality, however, the fading profiles vary across the whole frequency band, and even the same subcarrier experiences independent attenuation when assigned to MSs in different locations.

Each scheduling decision involves constructing a frame of one or more time slots. Within each time slot multiple carriers must be assigned to users. The important aspect is that a scheduler knows the channel rates across all users and all carriers whenever a scheduling decision is made.

II. MOTIVATION

Providing quality of service (QoS), in particular meeting the data rate and packet delay constraints of real-time data users, is one of the requirements in emerging high-speed data networks. This requirement is particularly challenging in networks that include wireless links. Indeed, quality of a wireless channel is typically different for different users, and randomly changes in time on both slow and fast time scales. In addition, wireless link capacity is usually a scarce resource that needs to be used efficiently. Therefore, it is important to find efficient ways of supporting QoS for real-time data (e.g., live audio/video streams) over wireless channels (i.e., supporting as many users as possible with the desired QoS). Efficient data scheduling is one of the ways to address the issue described above. In this article we consider the problem of scheduling transmissions of multiple data users sharing the same wireless channel so as to satisfy delay or throughput constraints of all, or as many as possible, users. This problem can be referred to as a multi-user variable channel scheduling problem.

III. MECHANISM AND ALGORITHM

The scheduling problem in the presence of network coding in two-hop OFDMA relay networks is addressed .The widely used proportional-fair scheduling policy, which provides a good balance between network throughput and system fairness. The figure1 denotes the overall structure of this paper. Initially, the network model of OFDMA network is created so that the scheduling algorithm can be carried out. Thus improves the network throughput and fairness in the transmission. At last, the comparison of both the scheduling is done in the analysis part of this work.

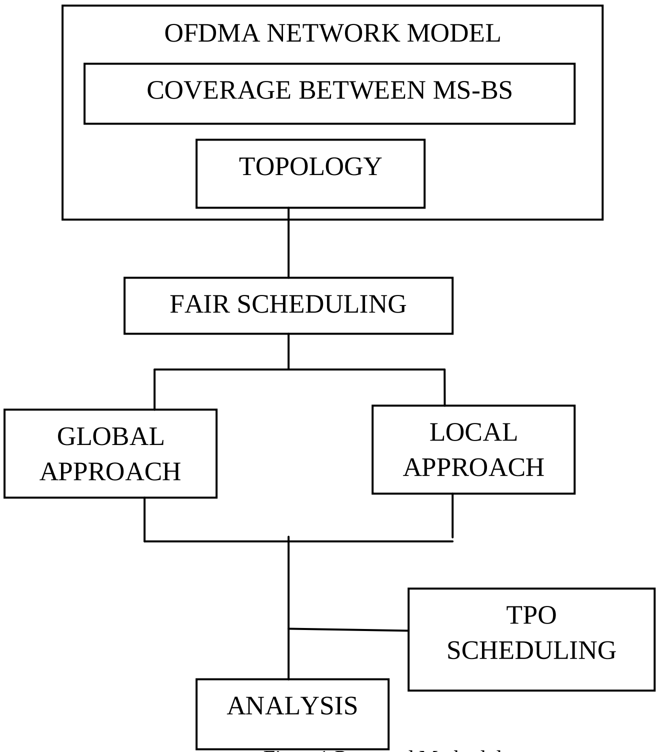


Figure1 Proposed Methodology

The scheduling is carried out by the base station to allocate subchannels to all mobile station so that as a result all stations are served in efficient and fair manner. On the other hand, during bidirectional flows pass through relay stations improves throughput. But, downlink and uplinks are scheduled separately in the existing work, thereby missing network coding opportunities. To ensure that both the BS and MS can receive the data successfully, the achieved broadcast rate is bounded by the lower one of rates over links (RS, BS) and (RS, MS), leading to a diminished throughput if one of the link rates is very low. Therefore, the scheduling decision should be made under a well-devised network coding mechanism.

A. Network Model

A two-hop OFDMA relay network in the network consists of one BS, a set of RSs R and a set of MSs M. Each MS connects to the BS directly or via an RS according to predetermined routing scheme, such as using the transmission time based metric. The prescribed frequency band is divided into a set of multiple orthogonal subchannels that are allowed to be used by all stations.

Each frame consists of T time slots and C subchannels. the frame is partitioned into three sequential subframes named downlink subframe, uplink subframe, and relay subframe. As the names suggest, the downlink subframe is used by the BS to transmit data to RSs, the uplink subframe is used by MSs to upload data to RSs, and the relay subframe is used by RSs to forward the received data to respective MSs and BS with or without network coding.

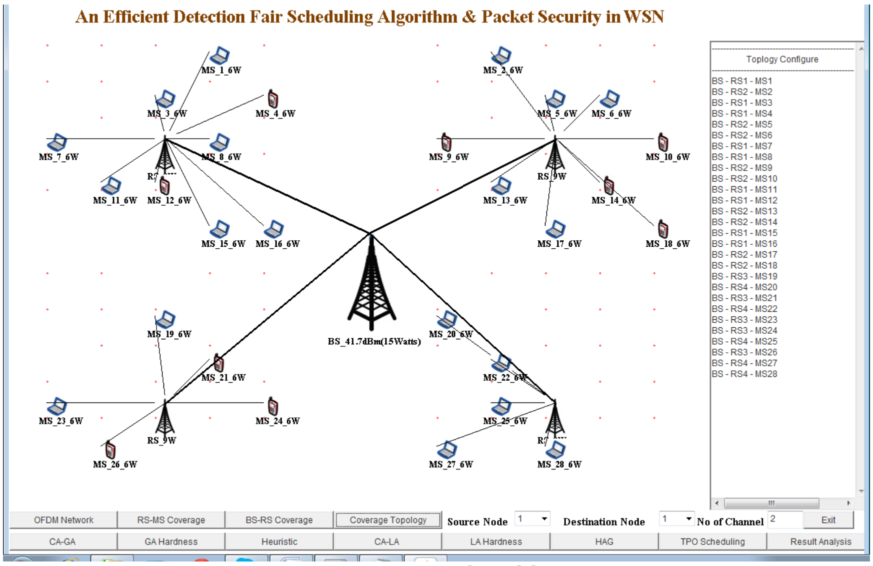


Figure2 Network model

B. Proportional fair Scheduling

Proportional fair is a compromise-based scheduling algorithm. It's based upon maintaining a balance between two competing interests. Trying to maximize total throughput while at the same time allowing all users at least a minimal level of service. This is done by assigning each data flow a data rate or a scheduling priority. Generally, the BS makes the scheduling decision according to some optimization objective, and then disseminates the result in the preamble of each frame. To maintain a good balance between network throughput and system fairness, the proportional-fair scheduling, which is a popular scheduling policy, and used in OFDMA systems. The maximizing objective function in each frame is given by

$$\sum_{m \epsilon M} \frac{d_m}{D_m} + \frac{u_m}{U_m}$$

where d_m (u_m) is the total downlink (uplink) data amount in bits for MS m to be allocated in the current frame, and D_m (U_m) denotes the average downlink (uplink) rate for MS m. It includes two approaches, local approach and global approach

a) Global approach

The global approach aims at fully exploiting multiuser diversity and frequency selectivity, as well as network coding gain, by acquiring all link rate information over the whole network. It works as follows: First, all data rates in bits/slot captured through channel state information (CSI) at all links for each subchannel are reported to BS. Then, the BS runs algorithm to make the scheduling decision. Finally, the BS broadcasts the scheduling decision during the transmission of the preamble. Emulated MaxWeight(EMW) determines the subchannel allocation for the data transmission. The weight is assigned to the subchannel for the respective MS. Once the assignment of all subchannels in the relay subframe is determined, according to the flow conservation constraints, the upper bounds of data amounts for each MS m will be also known.

b) Local Approach

At the beginning, the link rates are fed back to their corresponding RSs. Each RS then calculates the maximum attainable value v_m of $\frac{d_m}{D_m} + \frac{u_m}{U_m}$ for each associated MS m, under the assumption that the whole frame is used to serve m. Subsequently, the largest v_m from its MSs is reported to the BS. Finally, the BS picks the MS $\hat{\boldsymbol{m}}$ with the largest v_m , and broadcasts the decision that $\hat{\boldsymbol{m}}$ will be served during the next whole frame.

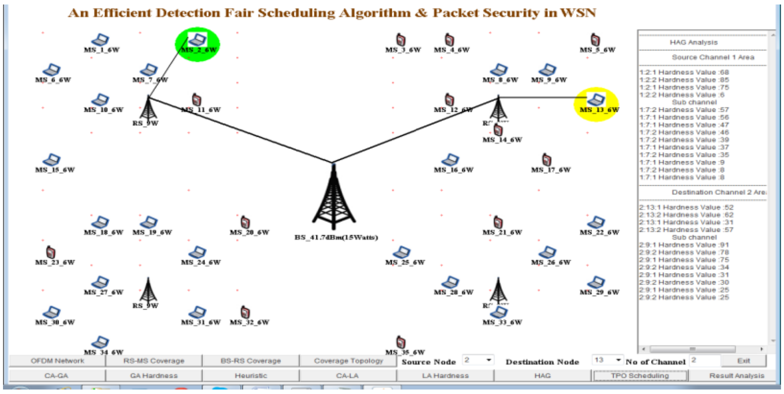
In the greedy algorithm HAG, the sub channels in the relay subframe, numbered as 1,2, . C3, are assigned in sequence. Let $\boldsymbol{Q_m^d}$ and $\boldsymbol{Q_m^u}$ be the residual data amount for downlink and uplink traffic, respectively, before subchannel c is allocated. Initially, we have $\boldsymbol{Q_1^d = Q^d}$ and have $\boldsymbol{Q_1^u = Q^u}$. The subchannel allocation is conducted based on a weight $w_c(k)$ that is defined for subchannel c working on mode k.

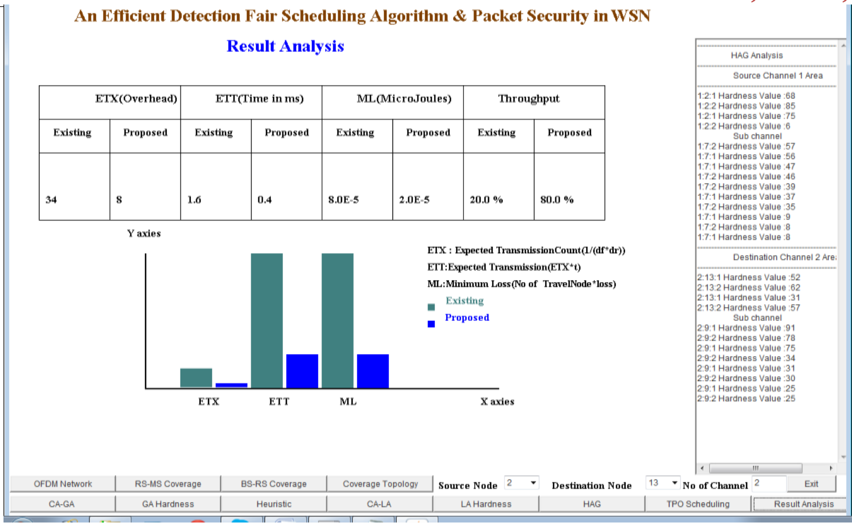
c) TPO Scheduling

The TPO (Traffic Pattern Oblivous) scheduling algorithm works in rounds. In each round, the algorithm assigns one new transmission slot to each node that has not been assigned its required number of transmission slots. Note that a node rooted at a subtree of size x needs a total x transmission slots. Thus, each round i involves all the nodes rooted at subtrees of sizes at least i. Here, in TPO scheduling each sensor node knows its parent, children and size of the subtree. Normally, such information is readily available at each node after the routing tree is constructed. Each node chooses its transmission slots. Each round of scheduling is conducted by circulating TOKEN messages. The BS generates TOKEN and passes to one of its children. When sensor node receives TOKEN from parent it starts the new round on slot. If the node already receive TOKEN message, it forwards TOKEN. The process continues until all nodes are satisfied.

IV. Results

The OFDMA networks are formed in GLPK toolkit, so that results are simulated using this tool. The existing scheduling algorithms involves in reducing the traffic between the nodes involved in the topology. But, the TPO scheduling implemented in OFDMA network shows the improving values in transmission, throughput etc. These are shown below.





V. CONCLUSION

The network coding-aware scheduling problem in OFDMA relay networks is studied under the proportional fair scheduling policy. Then local and global approach is used to solve the problem under a tradeoff consideration between performance and overheads. For each model, we establish its hardness and propose efficient algorithms with low time complexity. The schedule also allows the base station to conclude data collection as early as possible. The proposed schedule is traffic pattern oblivious in that it achieves high energy efficiency and time efficiency of data collection irrespective of the traffic pattern.

References

1. R. Ahlswede, N. Cai, S.Y. Li, and R.W. Yeung, "Network Information Flow," IEEE Trans. Information Theory, vol. 46, no. 4, pp. 1204-1216, July 2000.
2. S. Katti, H. Rahul, W. Hu, D. Katabi, M. Medard, and J. Crowcroft, "XORs in the Air: Practical Wireless Network Coding," Proc. ACM SIGCOMM, 2006.
3. M. Ergen, S. Coleri, and P. Varaiya, "QoS Aware Adaptive Resource Allocation Techniques for Fair Scheduling in OFDMA Based Broadband Wireless Access Systems," IEEE Trans. Broadcasting, vol. 49, no. 4, pp. 362-370, Dec. 2003.
4. M. Andrews and L. Zhang, "Scheduling Algorithms for Multi-Carrier Wireless Data Systems," Proc. ACM MobiCom, 2007.
5. S. Mengesha and H. Karl, "Relay Routing and Scheduling for Capacity Improvement in Cellular WLANs," Proc. Modeling and Optimization in Mobile, Ad Hoc and Wireless Networks (WiOpt), 2003.

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