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COMPETITIVE RESOURCE ALLOCATION IN HETNETS: PRICING , BANDWIDTH ALLOCATION AND SPECTRUM SHARING

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Abstract - *To furnish consistent versatility with high velocity remote availability, group of people yet to come remote organizations should uphold heterogeneous remote access. Estimating plans embraced by various specialist co-ops is critical and will affect the choices of clients in choosing an organization. In this article, they give a far reaching study of the issues identified with valuing in heterogeneous remote organizations and potential ways to deal with the arrangement of the estimating issue. To begin with, we survey the connected work on evaluating for homogeneous remote organizations where a solitary remote innovation is accessible to the clients. At that point, we layout the significant issues in planning asset designation and estimating in heterogeneous remote access organizations. To comprehend these difficulties and tradeoffs they present a two-level heterogeneous remote organization model with two kinds of clients: portable clients that can just interface with macro-cells; and fixed users that can associate with either macro-cells or small-cells. The conceivable Nash equilibria for various framework boundaries are arranged into four classes comparing to whether diverse SPs relegate data transmission to the large scale or potentially little cells. Every SP's(Service Providers) HetNet (heterogeneous networks)consists of two sorts of cells(macro-and little) and two kinds of clients, versatile and fixed. The little cells serve fixed clients just, while the full scale cell filter serves either client type. Related with every phone type is its complete rate limit, where the all out appraised limit of a little cell is ordinarily bigger than that of a large scale cell with a similar measure of data transmission.*

Key Words: **Service Providers, HetNet (heterogeneous networks), macro-cells or small-cells**

1. INTRODUCTION

Game Theoretic Approach — In general, a wireless system may consist of multiple entities whose objectives are different and possibly conflict with each other. In such a case, a solution which is optimal from the global point of view, may not be desirable by all the entities. For example, the total revenue is maximized if each of the service providers allocates all of the radio resources to the user offering the highest price, while other users do not receive any resource. Instead, a solution that ensures satisfaction of all the entities in the system is desirable. In this multi-entity environment, non-cooperative game theory can be used to obtain the optimal pricing policy. Here, the competition can be either among user entities, who compete for the radio resource, or among service providers, who offer wireless services to the users. The most popular solution of this competitive situation is the Nash equilibrium concept, which guarantees that none of the entities in the system wants to change its strategy, given that other entities stick to the Nash equilibrium. Based on the competition among users in a CDMA cellular system, distributed power control and pricing adjustment algorithms were proposed, where the objective of each user was to maximize its individual net utility (instead of total or group net utility as in) The net utility was computed based on the amount of successfully transmitted data, which is a function of SIR at the receiver. However, increasing the transmission power by one user increases interference to other users. A non-cooperative game was formulated, and Nash equilibrium was used to obtain the transmission power and the price (per unit transmission power).In cognitive wireless networks, where primary (or licensed) users can offer (or sell) spectrum opportunities to secondary (i.e., unlicensed) users, competitive pricing for spectrum trading becomes an important issue. The pricing method in this competitive environment can be either secondary user driven or primary user driven. In a secondary user-driven scheme, the secondary users request (i.e.,bid) for the spectrum, and a primary user makes a decision on rice and allocates spectrum opportunities to the secondary users accordingly. On the other hand, in a primary user-driven scheme, primary users determine the prices of available spectrum. A secondary user makes its decision based on offered spectrum price and quality of wireless transmission on the corresponding spectrum. In both the cases, the competition can be modeled as a non-cooperative game, and the solution non spectrum pricing can be obtained from the Nash equilibrium. In a multi hop network, traffic of a user can be routed through multiple nodes to the destination. As a result, a user must pay the intermediate nodes for functioning as relays. This pricing problem in a multi hop network was considered in the literature, for example, in. In this case, the relay nodes can optimize the price charged to the upstream nodes of a traffic flow to maximize the profit. A non-cooperative game model was developed to obtain the competitive solution among the nodes in a multi hop network

2. LITERATURE REVIEW

C. Chen *et al.*, 2015 .,The current 3G-Cellular radio access network cannot support many concurrent high data rate unicast or multicast flows due to limited radio resources.

The value of the heterogeneous architecture depends on the Cellular network's ability to utilize the local ad hoc networks in order to reduce the 3G coverage needed for multicast streaming. Our overall contribution is a framework to increase the availability of multipoint streaming services to wireless users; the contribution includes a detailed evaluation of the trade-off between the 3G coverage and the ad hoc spanning tree size.

A. Ghosh et al., 2012,With the pervasive penetration of wireless technologies in our lives, the wireless spectrum has finally been dried-up. However, preliminary studies and general observations indicate that a large portion of licensed spectrum are not in use for a significant amount of time at a large number of locations. These finds and the need for more efficient utilization of wireless spectrum lead to the proposal of cognitive radio technology as a new mechanism for flexible usage of spectrum. To address the impact of the network dynamics on video streaming, the playout buffer is typically deployed at the receiver to guarantee the smooth media playback. Given the channel conditions and the video packet storage in the play out buffer, we propose a centralized scheme for provisioning the superior video service to users.

3. PROPOSED SYSTEM

The work investigates the interplay of interference and service pricing on user adoption of small-cells when small- and macro-cells operate in common spectrum and when they operate in fixed separate bands. The authors conclude that almost all users choose small-plus-macro service and pay a higher price. The pricing and bandwidth allocation decisions are obtained via a two-stage process. In the first stage each SP determines how bandwidth is split between macro- and small-cells. In the second stage, each SP sets two prices for accessing the macro- and small-cell networks. This order is motivated by the observation that determining the bandwidth split may occur over a slower time-scale than price adjustments. At equilibrium the macro-cells only serve mobile users, and fixed users only associate with small-cells. The prices in macro-cells are always higher than the prices in small-cells. This market structure applies irrespective of the number of SPs, and whether the SP(s) maximize (individual) revenue or social welfare. This is consistent with the current small-cell deployments in practice, where small-cells are primarily used in indoor systems. Additional properties of the equilibrium are also characterized, for example, it cannot be the case that one SP provides only macro-cell service while another provides only small-cell service. (However, one SP can provide macro-cell service and another can offer both macro- and small-cell service.) Moreover, we show that the Nash equilibrium can be computed via a sequence of coordinate gradient-based updates, and use this to illustrate numerically how the equilibrium changes with initial bandwidth endowments.

4. SYSTEM DESIGN

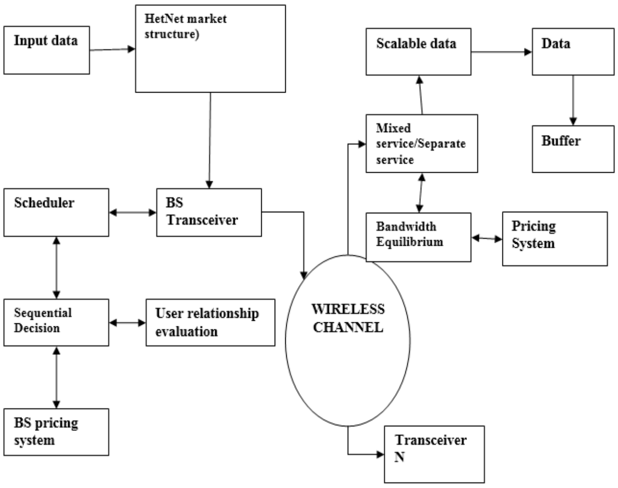

Fig:1 Pricing And Bandwidth Allocation Decisions .

5. SEQUENTIAL DECISION PROCESS

The bandwidth and price adjustments of SPs in the network as a two-stage process:

1) Each SP first determines its bandwidth allocation between macro-cells and small-cells. Denote the aggregate bandwidth allocation.

2) The SPs announce prices for both macro-cells and small-cells. The users then associate with SPs according to the previous user association rule. This order reflects the fact that bandwidth partitioning takes place over a slower time-scale than price adjustments, since changing the bandwidth partition could conceivably involve reconfiguring equipment at both base stations and handsets, and adjusting the placement of access points along with transmission parameters in order to keep the rate per cell fixed. Adjustment of prices would not require these additional changes.

The average energy efficiency, throughput, and transmit power consumption performance of the proposed algorithms were evaluated and compared to other baseline works. When the available spectrum of both groups is very small, the prices are high in both type of cells. In that case, it is better for SPs to allocate all bandwidth to small-cells since that results in more data rate and therefore more revenue. However, if one group of SPs has a large amount of bandwidth, allocating all bandwidth to small-cells significantly decreases the price in small-cells. Thus, it is beneficial to invest in both small-cells and macro-cells to maximize revenue.

1) All bandwidth is allocated and prices are set so that the total rate demand is equal to the supply.

2) The bandwidth allocation falls into the separate service case.

Theorem 1 (Existence of Nash Equilibrium):

A sub game perfect Nash equilibrium always exists for the bandwidth and pricing game and every equilibrium falls into

the separate service case.The proof of this theorem has two steps. We first prove that no Nash equilibrium exists in the mixed service case. We thenprove that a Nash equilibrium always exists in the separate service case using Rosen's Theorem .

Even under the separate service case, the equilibria can fall into one of the following distinct cases:

1) Small-cell only Nash Equilibrium (SNE): All SPs only allocate bandwidth to small-cells.

2) Macro-Small-cell Nash Equilibrium (MSNE): All SPs allocate bandwidth to both macro- and small-cells.

3) Small-cell Favored Nash Equilibrium (SFNE): A subset of SPs only allocate bandwidth to small-cells and the other SPs allocate bandwidth to both macro- and small-cells.

4) Macro-cell Favored Nash Equilibrium (MFNE): A subset of SPs only allocate bandwidth to macro-cells and the other SPs allocate bandwidth to both macro- and small-cells.

6. CONCLUSION

When the available spectrum of both groups is very small, the prices are high in both type of cells. In that case, it is better for SPs to allocate all bandwidth to small-cells since that results in more data rate and therefore more revenue. However, if one group of SPs has a large amount of bandwidth, allocating all bandwidth to small-cells significantly decreases the price in small-cells. Thus, it is beneficial to invest in both small-cells and macro-cells to maximize revenue. However, certain classes of Nash equilibria are asymptotically socially optimal when the number of SPs tends to infinity. In order to achieve the benefits of competition, we have to ensure full competition in every active market. Otherwise, even an infinite number of SPs may not yield the socially optimal outcome. Specifically, certain classes of equilibria (MFNE and SFNE) are not asymptotically socially optimal since only a subset of the SPs compete in either the macro- or small-cell markets. Furthermore, a resource allocation strategy is devised to suit the virtualization framework. "Adaptability ratios" are introduced to model network suitability to different services. Combining "adaptability ratios" with Nash bargaining, an iterative resource allocation algorithm is devised. Through simulation, the advantages of the proposed algorithm are validated.

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