Cooperative Pilot Power Control in Relay Based Cellular Networks

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Abstract. Relay based cellular networks (RBCN) use relay stations to enhance the coverage and QoS offered to mobile users (MS). This paper introduces an algorithm to control the power at the relay stations (RS) and the base stations (BS) of a RBCN in manner to optimize the QoS to the mobile users over the whole network. The performance of the algorithm is evaluated using a Mobile WiMAX simulator and the results are compared to a simpler greedy algorithm and a conventional RBCN resource allocation scheme.

Keywords: Relay based cellular network, Cooperative control algorithm, Pilot power, Mobile WiMAX

1 Introduction

Cellular networks (CN) [1] carry out various resources management schemes like frequency reuse, seamless roaming and simple topologies to improve their capability. Relay based cellular networks [2] gain higher capability by adding RSs to the cells. This is attractive as it has a low investment to income ratio, provides flexibility in networks construction, and can be used to fill in holes. RBCN are the networks discussed in this paper.

RBCNs face certain problems. One of the main problems is un-balanced demand distribution. Also a MS may need different kinds of services like voice, real time audio and video-stream. The lack of mobility of BS and RS is a different kind of problem. A BS is fixed and can only cover a limited area. It is the same to RS. Not only network, wireless communication interferences in signal propagation are unavoidably affect RBCN performance, like path loss, shadowing, fast fading [3]. These problems make cooperative control necessary in RBCN.

Cooperative control is devised for carrying out geographical load balance [4] by controlling BS and RS performance cooperatively. Through this scheme, RBCN can avoid coverage hole, offer QoS to MS. Basically when MSs distribute un-evenly, some BSs will be heavily loaded. They need cooperatively be controlled to deliver some services to nearby BS which is not so crowed by MS. In section 2, a revised cooperative pilot power control algorithm (R-CPPCA) is introduced.
2 Revised Cooperative Pilot Power Control Algorithm

R-CPPCA works in RBCN with 60 degrees sector and omni-directional antenna.

The main mechanism of the R-CPPCA is: in each iterative running, it uses Utility comparison to find the best entity to expand coverage by one coverage band (as shown is Fig.1.). Then its neighbor entities shrink coverage if the overlap area beyond certain threshold without causing coverage hole (as shown in Fig.2.). The best entity satisfies three criterions: First, it can cover as many un-served MSs as possible if it expands its current coverage by one band. Second, most part of these new covered MSs can get optimal service from this expanded coverage. Third, its cell expanding causes less nearby entity losing MS subscription. Nearby entity will lose MS subscription, because algorithm performs overlap area limitation to acquire

![Fig.1. Sector Coverage Band Division In One BS](image)

<table>
<thead>
<tr>
<th>Sector 5 in BS1: Band 3</th>
<th>Sector 2 BS2: Band 5</th>
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<tr>
<td>Sector 5 in BS1: Band 4</td>
<td>Sector 2 BS2: Band 4</td>
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![Fig.2. Sector to Sector coverage adjustment scheme with overlap area threshold of 2](image)

References