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TRUSTED MECHANISM AND DEPENDENT LEADER ELECTION MECHANISM FOR INTRODUCTION DETECTION SYSTEM

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ABSTRACT: Multi hop cellular networks offer increased coverage and capacity compared to single hop cells of the same size. This is not as huge as using more base stations (BS) instead of wireless relay nodes (RN), but by this way there is no need for a fixed network access to each node. Therefore a cost-efficient deployment is easily achieved (less CAPEX and OPEX). Even when the coverage of a BS is already quite good, relays help to increase the overall system capacity.

We deal with the rate allocation problem for downlink in a Multi-hop Cellular Network. A mathematical model is provided to assign transmission rates in order to reach an optimal and fair solution. We prove that under some conditions that are often met, the problem can be reduced to a single hop cellular network problem. The validity of our proof is confirmed experimentally.

KEYWORDS: Cellular networks relay nodes, leader election mechanism, DCH.

I.INTRODUCTION:

Multihop Cellular Network preserves the benefit of conventional single-hop cellular networks where the service infrastructure is provided by fixed bases, and also incorporates the flexibility of ad-hoc networks where wireless transmissions through mobile stations in multiple hops is allowed. In ad-hoc networks, nodes communicate with each other in a peer-to-peer way and no infrastructure is required. If direct communication is not feasible, the simplest solution is to replace a single long-range link with a chain of short range links by using a series of nodes between the source and the destination: this is known as multi-hop communication. The cooperation between these two networks can be interesting as ad-hoc networks can expand the covered area whit out the high cost of cellular networks infrastructure. We address in this paper a bottleneck problem that summarizes the situation of many multi-hop cellular networks,. In our work, a gateway - or *base station (BS)* - has entire access to the rest of the world and provides this service in a more privileged way to some specific nodes, the *relay nodes* (the white ones in Figure 1). Those nodes are themselves relaying the service to the nodes in the free zone, called the *terminal nodes* (the gray ones in It can happen that nodes in the free zone relay one another to get the final service. In our model, the relay nodes and the gateway form a single-hop cellular network (the critical zone) that constrains the system. Each node has a utility function representing its degree of satisfaction based on the assigned rate transmission. Relaying is rather new for LTE. In contrast to adhoc networks, fixed relays are placed at positions that were planned in advance. They provide improved coverage and capacity of the relay enhanced radio cells. That is why they are proposed for standards of next generation cellular systems. The demand for high data rates in large areas is omnipresent, but the offer of conventional cellular architectures does not match this demand. First, the limited power problem: For a given transmit power level, the higher transmission rates lead to a lower energy per bit. Second, the radio propagation: Above a few GHz the vulnerability to bad non-line-of-sight conditions is higher. In effect, the path loss is higher between base stations and mobile. Third, the maximum data rate offered by a base station depends on the distance of the mobile to the base station, but the demand density is constant. Close to the base station a higher *SINR* value is achieved, which allows the highest Modulation & Co ding scheme (PhyMode) and therefore the highest data rate. At the cell edge the offered data rate is one order of magnitude lower (*QPSK*13 compared to *QAM*645 6 for LTE). A transmission of a certain data rate therefore requires ten times more radio resources at the edge than near the BS. For this reason, the average cell capacity is heavily determined by the PhyModes at the cell border. While placing more base stations (BS) per area seems to be a solution, this comes with much higher costs due to the fixed network access by fiber. In this paper we consider the deployment of Fixed Relay Stations, also called Relay Nodes (RN), which are fed over the same wireless technology. The cellular basic structure stays ideally hexagonal, if we place RNs within the original cell (Figure 1) in order to improve the capacity of the cell. The basic structure changes to three hexagons if we place RNs at the former border, so now there are hexagons around the three RNs and one BS at the intersection of the three hexagons. Sectorization of antennas is an additional way to reduce interference to neighbor cells.

Cluster orders (frequency reuse factors) of three to twelve are common to have a guard distance between interfering cells. We can even utilize a spatial reuse among the RNs, i.e. let RNs transmit in parallel into different segments. Directional antennas at the RNs can then avoid any interference into the peer segments. In this paper we do not consider MIMO techniques, but their use is independent of relaying.

II RELATED WORK

This described scenario occurs in multi-hop networks as considered in. Indeed, it is observed that often in these networks the bandwidth is constrained specifically by a bottleneck around the gateway [5,6], confirming the fact that it is a representative area. Many real networks deal with this situation. For instance, using UMTS technology for the single-hop network, while the free zone is covered by WiFi or Bluetooth systems. We show that there exists a set of utility functions that can be assigned to the relay nodes replacing the complete set of utility functions. It is due to the fact that the problem is convex under some conditions that are often met.

Convex optimization techniques are important in engineering applications because a local optimum is also a global optimum in a convex problem. Rigorous optimality conditions and a duality theory also exist to check the solution optimality.

Consequently, when a problem is cast into a convex form, the structure of the optimal solution, which often reveals design insights, can often be identified.

Furthermore, powerful numerical algorithms exist to solve convex problems efficiently. We are interested in Pareto-optimal solutions that are solutions where the utility of an individual cannot be improved without decreasing the utility of one or more other nodes. The fairness is a key issue in wireless networks, since the medium is shared among the nodes. In our problem, it implies that each flow going through a bottleneck receives a fair share of the available bandwidth. Our work admits the generalized fairness criterion as defined in that can assume several criteria, for example, the proportional fairness one.

The proportional fairness has been studied in the context of the Internet flow due the similarity to the congestion control mechanism of the TCP/IP protocols, where each TCP’s throughput is adapted as a function of the congestion. The work in [9] addresses the question of how the available bandwidth within the network should be shared between competing streams of elastic traffic.

III. AN OVERVIEW OF ICAR SYSTEM

In this section, we describe briefly the principle of operation and the main benefits of iCAR system (see [4] for more details). To simplify the following presentation, we will focus on cellular systems where each BTS is controlled by a Mobile Switching Center (MSC) Each ARS has two air interfaces, the C (for cellular) interface for communications with a BTS and the R (for relaying) interface for communicating with an MH or another ARS. Also, MHs should have two air interfaces: the C interface for communicating with a BTS, and the R interface for communicating with an ARS. In addition, each ARS is under the control of a MSC, and has limited mobility. Such a feature is important to ensure that a relaying route can be set up fast and maintained with a high degree of stability. Routing in the proposed system is similar to that of having a hybrid (both hierarchical and flat) structure in [8] for efficient routing and hand-offs in mobile ATM networks. The difference between the two is that in the latter, path extension (or relay) is between two (fixed) BTSs through direct wired links. The R interface (as well as the medium access control (MAC) protocol used) is similar to that used in wireless LANs or ad hoc networks. Note that because multiple ARSs can be used for relaying, the transmission range of each ARS using its R interface can be much shorter than that of a BTS, which implies that an ARS can be much smaller and less costly than a BTS.

At the same time, it is possible for ARSs to communicate with each other and with BTSs at a higher data rate than MHs can, due to limited mobility of ARSs and specialized hardware (and power source). In the iCAR system relaying occurs even without occurrence of congestion in the network, such that whenever there is a difference in traffic pattern among neighboring cells the relays are activated to mitigate the difference. Interference in cellular band due to channel borrowing is avoided in this scheme. However, one still needs to take care of the interference issues in the ISM band.

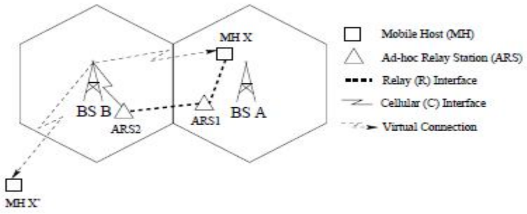

Figure 1: Primary relaying. Mobile host X (*MH X*) in cell A operates on a channel from base station B via ISM band relays.

3.1 **Primary Relaying**: In an existing cellular system, without any load balancing strategy incorporated, if MH X in Fig. 1 is involved in a new call (as a caller or callee) but it finds no DCH in cell A at that moment, the new call will be blocked. In the iCAR system, MH X in cell A, can *switch over* to the R interface to communicate with an ARS in a neighboring cell (cell B, which is less congested), possibly through other ARSs in cell A (see Fig. 1 for an example), and thus the call can be served directly by relaying. We call this strategy *primary relaying*. The process of changing over from C interface to R interface (or vice versa) is referred as switching-over, which is similar to (but different from) frequency-hopping [6],[19],[20]. A relaying route between MH X and its corresponding (i.e., caller or callee) MH X can also be established, in which case, both MHs need to switch-over from their C interfaces to their R interfaces, even though the probability of this event is typically very low.

3.2 Secondary Relaying: If primary relaying is not possible, because, for example in Fig. 1, ARS 1 is not close enough to MH X to be a proxy (and there are no other nearby ARSs), then one may resort to *secondary relaying* so as to free up a DCH from BTS A for MH X. An example is given in Fig. 2(a), where MH Y denotes any MH in cell A which is currently involved in a call. One may establish a relaying route between MH Y and BTS B (or any other neighboring less congested cell). In this way, after MH Y switches over, the DCH freed by MH Y can now be used by MH X. Note that, since the probability of finding an on-going call covered by an ARS is much higher than that of a blocked call, the likelihood of secondary relaying is much higher than that of primary relaying. In addition, although the concept of having an MH-to-MH call via ARSs only (i.e., no BTSs are involved) is similar to that in ad hoc networking, a distinct feature (and advantage) of the proposed integrated system is that an MSC can perform (or at least assist in performing) critical call management functions such as authentication, billing, and locating the two MHs and finding and/or establishing a relaying route between them, as mentioned

3.3 Cascaded-Secondary Relaying: If neither primary relaying (as shown in Fig. 1), nor basic secondary relaying (as shown in Fig. 2(a)) works, the new call may still be supported. As shown in Fig. 2(b), one may apply the basic secondary relaying strategy twice in cascade, to relay an ongoing call from a host (MH Y) to a cell (cell C in Fig. 2(b)). In this way, the freed channel can be allocated to a new host (MH X), while a borrowed channel from cell C will be allocated to the MH Y. We call this strategy *cascaded relaying*. Note that in this case cell B in our example (see Fig. 2) does not lose any channel capacity.

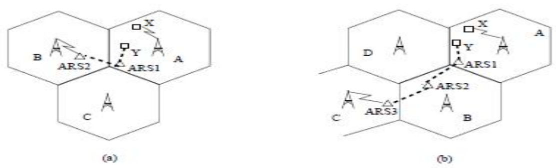

Figure 2: (a) Secondary relaying. *MH X* in cell A operates on a freed channel from *MH Y*. *MH Y* now operates on a borrowed channel from cell B via ARS_1 and ARS_2. (b) Cascaded-secondary relaying. *MH X* operates on a freed channel from *MH Y* in cell A. *MH Y* now operates on a borrowed channel from cell C via relays ARS_1, ARS_2, and ARS_3.

IV.PERFORMANCE EVOLUTION

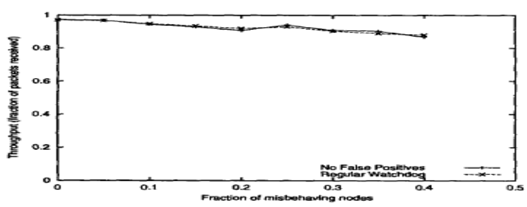

Fig 3: Misbehavior Nodes Detection Performance

V. CONCLUSION

This paper treats the properties and MAC performance of a multihop FDD mode cellular system. Two basic scenarios, the Coverage Extension Scenario and the Capacity Extension Scenario, are analyzed for relaying under various parameters. Multihop communication can provide an remarkable increase in link and network capacity, especially if we utilized possible antenna gains, directional antennas, and possible parallel transmissions of remote relays (SDM). The most important fact is that no fibre line access is required for relays and relay devices can be cheaply installed anywhere. If the association decision is done the right way by minimizing used resources, there will be always an advantage of having relays instead of base stations only. As result, the total spectral efficiency rises and not only area coverage but also the average system capacity is increased over the area.

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