論文 / 著書情報
Article / Book Information

題目(和文)	大規模基地局連携を用いた動的カバレッジ制御を実現する高度なセルラネットワークアーキテクチャに関する研究
Title(English)	Efficient architecture of cellular networks for dynamic cell structuring with large-scale base station cooperation
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Category(English)	Doctoral Thesis
種別(和文)	論文要旨
Type(English)	Summary

（博士課程）
Doctoral Program

論 文 要 旨

THESIS SUMMARY

専攻： Department of	Electrical and Electronic Engineering 専攻	申請学位（専攻分野）： Academic Degree Requested	博士 Doctor of (Engineering)
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要旨（英文 800 語程度）
Thesis Summary (approx.800 English Words)

In this thesis, a heterogeneous cellular network (HetNet) is considered and the architecture is developed step by step. The HetNet consists of a macro cell and several small cell BSs (SC-BSs) in the macro cell area is assumed. In general a nonuniform user distribution is assumed. Especially the cases in which a few distinct congestion zones exist in the network area are considered and the network performance is examined with each architecture. The ultimate goal is to construct an architecture that utilizes the network resources to the utmost extent.

The growing demand for the data traffic in cellular networks seems to be a persistent problem. This trend of data traffic demand motivates the constant efforts for introducing and implementing more efficient networks with higher capacity. The capacity enhancement can be addressed and studied in three different axes:

- use of new bands and increasing the bandwidth,
- employing communication techniques with higher spectral efficiency,
- and densification, which means installing and exploiting more base station (BS) antennas in the network.

The solution that is followed in this thesis can be categorized as a combination of a more efficient communication scheme and densification. The densification that is considered here is to deploy a number of SC-BSs within a macro cell area. Then, by means of coordination among small cells the interference is eliminated and a huge capacity is obtained. In other words, a dense network of SC-BSs covers an area in an orchestrated manner to utilize their resources to the utmost extent.

The thesis begins by considering the simplest case in which SC-BSs are standalone BSs that do not cooperate to each other. The performance of this scheme can be used as the basis for comparison for more advanced schemes. In next steps, the cooperation among SC-BSs and orchestrated operation of SC-BSs are introduced. The orchestrated operation of SC-BSs relies not only on the large scale coordinated multipoint (CoMP) among SC-BSs, but also on the adaptive coverage or the cell structure of each SC-BS. The adaptive coverage of a BS is in contrast to the studies on cellular networks which assume that the coverage range of each BS is fixed and therefore, BSs mainly communicate to the nearby users.

It is of great importance to introduce adaptive coverage in cellular networks, because the fixed rigid transmission range of BSs will result in the waste of the idle network resources in sparse/ vacant areas. Besides, from the technological point of view, it is possible to deploy BSs or SC-BSs that are capable of adapting their coverage. The coverage of a BS can be shifted by controlling the antenna beam direction. Especially, changing the vertical tilt angle of a BS's antenna affects the transmission range. If the coverage of BSs is fixed the BSs/SC-BSs required to be deployed in each area according to the worst case or the busiest time in that area. Quite the contrary, here the idea is to dynamically transfer idle network resources to the dense areas by dynamic cell structuring along with large scale CoMP among SC-BSs.

CoMP was originally introduced to improve the performance for cell-edge users, however, here the idea is extended to large scale cooperation among several SC-BSs that are not necessarily near to each other.

Basically, C-RAN architecture assists the implementation of large scale CoMP. In this thesis an efficient architecture for large scale CoMP in an orchestrated network of SC-BSs is introduced and evaluated in various scenarios and under different circumstances. This scheme responds to network traffic demands and dynamically fits the cells' structures and cooperative clusters to the traffic congestion areas. The numerical evaluations show that if the large-scale clusters and the coverages of SC-BSs are dynamically optimized according to the traffic demand several times higher capacity is obtained compared to the networks of cooperating SC-BSs without dynamic coverage. Here it is assumed that the macro BS and all SC-BSs are connected to a perfect C-RAN backhaul and therefore the formation of any cooperative cluster with arbitrary SC-BSs is feasible.

Beside a scheme for cell structuring and coordination, it is necessary to introduce a method for practical implementation. Therefore, in this thesis a protocol is introduced to realize the dynamic coverage control and large-scale cluster formation. This protocol provides the signaling and measurements required to setup the orchestrated network. In the protocol, it is tried to use the signaling and positioning that are currently available in 3GPP standards as much as possible. This guarantees the feasibility of the proposed scheme.

備考 ： 論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。

Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).