Chapter 6

Energy Efficient Transmission in Cellular Networks

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ABSTRACT

A cellular network is a kind of dedicated distributed network with wireless radio access, and nowadays, it is widely used in people’s lives. The statistics shows that currently there are 4 billion mobile subscribers in the world, and unquestionably, the cellular network has been playing the main role of energy consumption in ICT (Information and Communications Technology). This chapter discloses the status of energy consumption in the cellular network and introduces energy efficient transmission strategies for accessing a network of cellular networks, especially in cell selection and power control scopes. For future research perspectives, this chapter also introduces the roadmap of smart radio resource management for energy efficient transmission.

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INTRODUCTION

The spread of mobile connectivity is generating major social and economic benefits around the world, while along with the rapid growth of new telecommunication technologies like mobile broadband communication and M2M (Machine-to-Machine) networks, large number of various base stations will be employed into the network, which will greatly increase the energy expense and CO2 emission. In order to realize the green communication, variety of researches on the new energy utility and novel transmission technology are put in agenda, and most of them are aiming to degrade the overall system energy expense. In this chapter, instead of reducing the absolute energy expense, the research targets to orient more energy consumption into renewable energy based BSs (Base Station), which implies that the UEs (User Equipment), especially the cell edge UEs, will have preferential access to the BSs with natural energy supply; thus, the conventional energy expense and CO2 emission can be reduced. To realize the connection tendentiousness, two detailed approaches are proposed, the HO (Hand Over) parameter tuning for target cell selection and power control for coverage optimization. The system evaluation shows that, by proper setting of parameters in HO and power control, both of the two approaches can achieve appropriate balance between energy saving effect and system throughput impact.

BACKGROUND

Along with the rapid growing of telecommunication industry, mobile broadband access is expected to lead huge market growth. Nowadays, there are already more than 4 billion mobile phone subscribers in the world (GSMA, 2009; EARTH Project, 2009), which means every two persons in the world will own at least one mobile phone. As for the mobile broadband subscribers, the number will increase to 1.2 billion before 2012 (EARTH Project, 2009). The fast growth of customers also encourages the rapid updates of technologies. In the recent several years, the main body of new technologies like LTE (Long Term Evolution) is finished by specifications, and many operators of various countries are now planning to deploy LTE networks in the coming years. While following the birth of new networks, the number of BSs will increase further. In EARTH Project (2009), the data shows that the rollout of mobile broadband networks such as LTE is expected to take place on top of existing 2G and 3G networks with an increase of at least 25% in the number of base stations in the networks, just as 3G networks were rolled out on top of 2G with a corresponding increase in the number of base stations. Large number of BSs and huge scale of system will definitely lead to more energy consumption and further more CO2 emissions. In fact, the operators are already facing to the problem of high power expense. In David (2009), the situation of energy expense among the total OPEX (Operational Expenditure) for an operator is analyzed, which is illustrated in Figure 1.

For a European operator, the energy expense will take 18% from the total OPEX, and for an Indian operator, it becomes even worse, as the ratio increases to more than 30%. To improve the income, the operators should devote themselves to save more energy, not only for profit, but also for the living environment of human beings.

Nowadays, there are many companies, universities and other research institutions working together to contribute for the energy saving technologies in mobile communications, e.g. the MOBILE VCE (Eamonn, 2009), a three-year project with more than 15 industrial members and 4 universities. They are focusing on the Green Radio architecture and cross-stack protocols for power reduction. The EARTH project (2009) also a three-year project with more than 15 companies and universities. Their targets focus on high capacity and uncompromised QoS (Quality