

Context-Aware QoE-Price Equilibrium for Wireless Multimedia Relay Communications Using Stackelberg Game

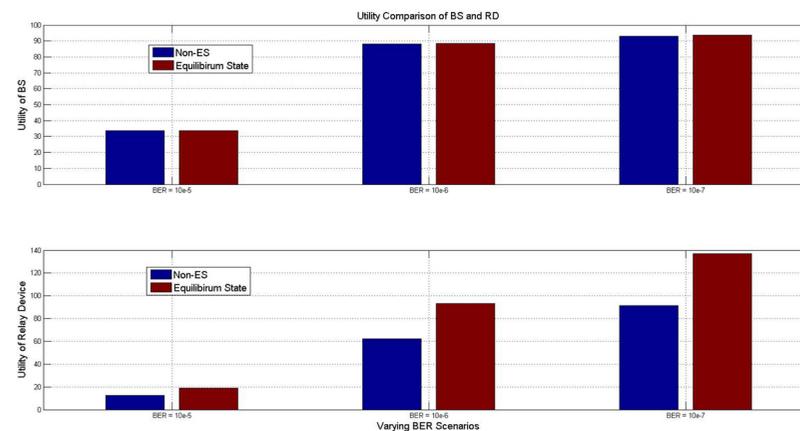
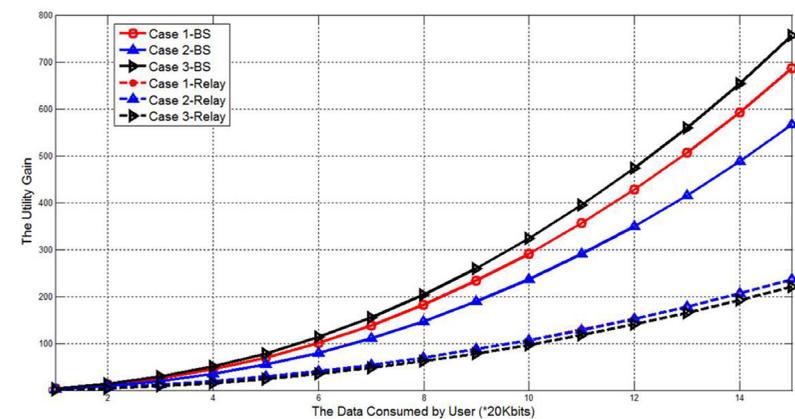
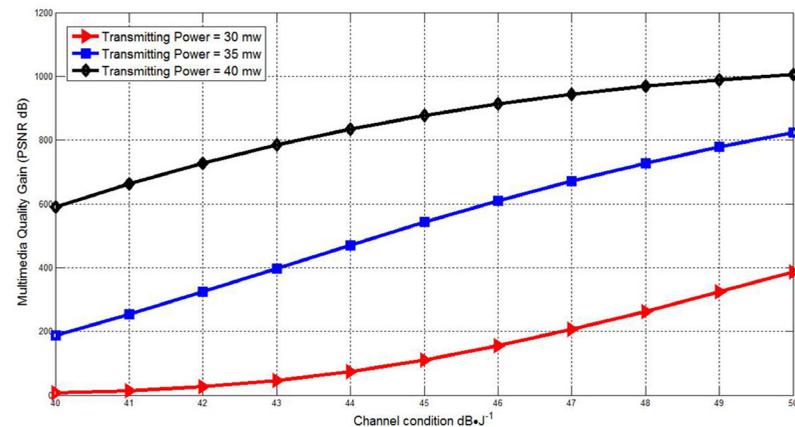
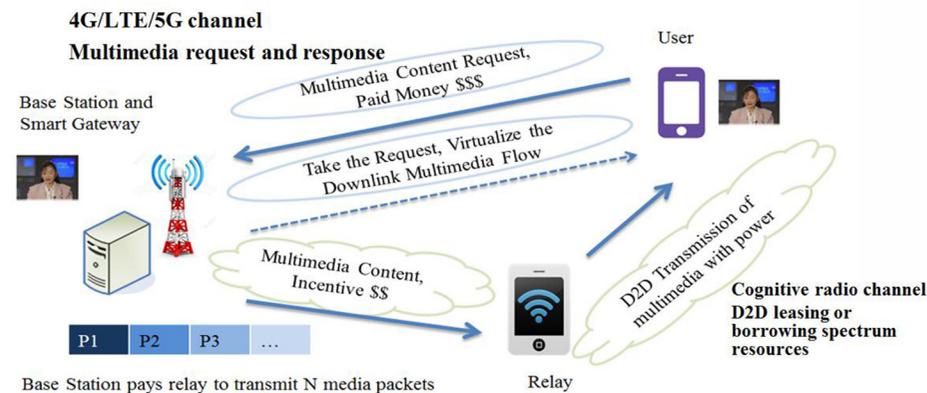


With the tremendous volume explosion of big data video contents in future wireless networks, ensuring Quality of Experience (QoE) of the End User (EU) by leveraging communication context becomes an important issue. In this research, we propose a context-aware wireless multimedia relay solution to

incentivize user devices participating in wireless relay services. In this proposed approach, QoE and price are jointly considered in a Stackelberg game model, providing economic rewards to the Relay Device (RD) which helps transmitting video contents between the Base Station (BS) and EU. The revenue of RD is numerically associated to the communication resource consumed by relaying video from the BS to the EU, while the utility of BS is quantitatively determined by the video QoE provided to the EU. We mathematically prove the existence of equilibrium state in the proposed Stackelberg game model. The simulation results show that players of EU, RD and BS in the system get desirable utilities in the QoE-Price equilibrium state.

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The context-aware multimedia relaying service scenario in Wireless Networks. User->BS: requests data and pays money. BS->RD: sends data to relay and buys power from relay for relaying data. RD->EU: finish the content relaying task through device-to-device (D2D) link.

The illustration of multimedia quality gain of EU. First, better channel will ensure higher service quality. Second, when the channel parameters are fixed, the bigger transmission power is, the higher multimedia quality EU will gain.

In our work, we define three price coefficient factors to universalize the unit of two utility functions. This makes it convenient for quantitative analyzing the game players' profit or revenue. From the simulation result we can see that the coefficient factors won't significantly change the utilities of BS and RD. The utility of RD is mainly decide by its transmission power and the price it charges to BS.

The overall system performance when we take the price and transmission power from the equilibrium state. We compare the fixed price and transmission power (Non-ES) to the proposed approach. As we can see that although the utility of BS increases very little bit in all cases, the utility of RD gets dramatically improved when we consider the Stackelberg game solution. The result indicates that when RD helps to relay data between BS and user, the high service quality that RD provides, the bigger utility BS and RD will get. Even in bad channel condition (10e-5), the BS and RD still obtain relative high utilities.