Analytical Model and Performance evaluation of Long Term Evolution for vehicle Safety Services

In traffic jam or dense vehicle environment, vehicular ad-hoc networks (VANET) can't meet safety requirement due to serious packet collision. The traditional cellular network solves packet collision, but suffers from long end-to-end delay. 3GPP Long Term Evolution (LTE) overcomes both drawbacks, thus it may be used instead of VANET in some extreme environments. We use Markov models with the dynamic scheduling and semipersistent scheduling (SPS) to evaluate how many idle resources of LTE can be provided for safety services and how safety applications impact on LTE traditional users. Based on the analysis, we propose to reserve the idle radio resources in LTE for vehicular safety services (LTE-V). Additionally, we propose the weighted-fair-queueing (WFQ) algorithm to schedule beacons for safety services using LTE reserved resource. Numerical results verify that the proposed mechanism can significantly improve the reliability of safety application by borrowing limited LTE bandwidth. We also build NS3 simulation platform to verify the effectiveness of the proposed Markov models. Finally, the reliability of applications including cooperation collision warning, slow vehicle indication and rear-end collision warning using DSRC with LTE-V are evaluated. The simulation results demonstrate that the stringent QoS requirement of the above three applications can be satisfied even under heavy traffic.