Improve Communications between Traffic Management Center and Traffic Measurement Sensor Elements in a Rural Environment

Yujie Liang[1] and Richard S. Wolff[2]
Montana State University, Electrical and Computer Engineering Department
507 Cobleigh Hall, Bozeman, MT 59717
Phone: 406 994-6651, Fax: 406 994-5958
[1]yujie.liang@myportal.montana.edu
[2]rwolff@montana.edu

Commission B Fields and Waves: Wireless communications

Abstract

The deployment of Traffic Measurement Sensor (TMS) field devices such as highway advisory radio (HAR), road weather information system (RWIS), changeable message sign (CMS), closed-circuit television (CCTV), and extinguishable message sign (EMS) serves are important functions in Traffic Management Center (TMC) operations. Numerous constraints, such as limited power, available bandwidth, RF spectrum, network scale, mobility and size have been explored and system architectures, protocols and device designs have been created to optimize performance. These solutions, however, do not readily apply in domains where the user density is low and range and terrain create challenging obstacles such as low data rates, low reliability, and high operational cost and maintenance cost. There is an urgent need to establish reliable, scalable, and economical solutions to the challenges of TMS filed device to TMC communication in rural and sparsely populated environment. Our research goals are to overcome these obstacles through physical, link, network, and application layer strategies. We explore the often overlooked rural and sparse domain, where distance, rugged terrain, and low density are the key parameters driving system design and performance. This paper presents our study results for system modeling, simulation and test installation of the most promising state of art wireless communication systems that operating at 700MHz, 800MHz, 900MHz, 2.4GHz, 5.8GHz and microwave backbone for connection TMS field device networks along Montana state high way. *OPNET Modeler* has been used to build a network model corresponding to different multi-hop topologies with sensor, node and link characteristics varied and the traffic generation randomly. *ComStudyII* has been used to calculation the radio coverage in the real world. *Herald* radio link analysis software has been used to calculate the distance between two nodes, given their latitudes and longitudes derived from *Google Earth*. *Google Earth* is also used to visualize the candidate sites for repeater nodes, enabling us to readily select locations with minimum terrain obstruction. The optimization of the wireless communication topologies, algorithms, and devise cost wireless for several specific difficult environments has been achieved.