WAVE devices support for wireless Internet access and intelligence transportation systems (ITS)

Applications

- Intelligent traffic management: adaptive traffic light control. toll collecting and travel information.
- High speed wireless access: Internet browsing, onboard entertainment and commerce transactions
- Enhanced safety: crash prevention and traffic jam alarm

Key Technologies

- Orthogonal frequency-division multiplexing (OFDM)
- Multiple input multiple output (MIMO)
- Adaptive modulation
- Wireless mesh networks

WAVE: The New Standard for Car Talk

-The IEEE 802.11p wireless access for vehicular environments (WAVE) standard

Introduction

WAVE systems offer enhanced safety, intelligent traffic management and wireless access for vehicles through the high-speed wireless links between vehicles and between vehicles and the roadside access points (APs) based on the IEEE 802.11p standard, ***expected to be ratified in 2007***. By adopting OFDM modulation scheme, WAVE systems achieve a data rate of 6-27Mbits/s and a WAVE device covers a range of 1000 feet. The Federal Communication Commission (FCC) has assigned the 5.850-5.925GHz band for the operation of WAVE systems.

WAVE requires intensive R&D and manufacture activities including function definition, algorithm development, system design, prototype assessment and massive production. The enormous market need of WAVE production could sustain one or several tier-one automobile large suppliers and many surrounding companies. Thousands of workshops are in need to install WAVE devices to existing billions of vehicles. Moreover, the WAVE service could foster one or several service operators with comparable sizes as big as cellular carriers. In summary, WAVE generates a fresh information technology industry on vehicle basis and brings up an opportunity to enhance the quality of life and intensify automobile's high-tech ingredients and competitiveness. The magnitude and degree of the impacts on Automobile industry in the worldwide are substantial, multi-layered and profound.

Research Team at University of Michigan

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A functional Prototype of WAVE Systems

In 2006, the research team at the University of Michigan, has established a WAVE testbed used to explore the characteristics of the 5.8GHz mobile channels, develop and integrate the WAVE functions. A measurement campaign was conducted in a typical mobile-to-roadside AP environment, shown in the following Fig.1. The transmitter is mounted in a van and the receiver is located at the roadside. During the testing, the roadside AP was fixed and the van ran on three designed traces I-III at speeds between 30-40 miles/h. Trace I is named parallel near while trace II parallel far and trace III perpendicular. The test field is a parking lot at the University of Michigan, Dearborn campus with a lot of parked vehicles. There are no pedestrians and moving vehicles at the time of data capture. More than 200 test signals were captured for each trace.

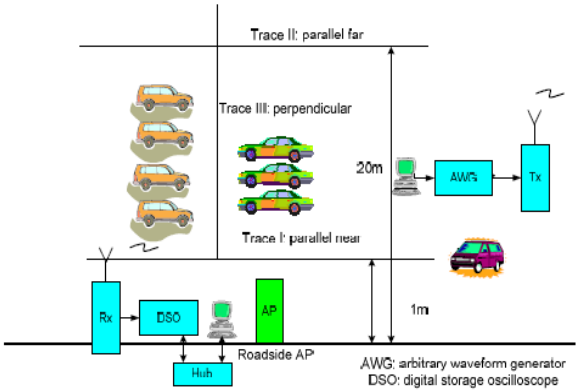

Fig.1 A WAVE testbed and the experimental scenarios

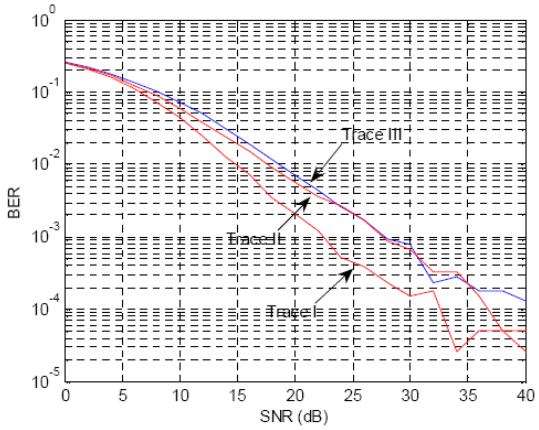

Fig.2 The BER-SNR performance of the WAVE

Relevant Publications

1. W. Xiang, P. Richardson and J. Guo, "An overview of wireless access for vehicular environments technology," to appear in the IEEE Wireless Communication Magazine.
2. X. Wang and W. Xiang, "An OFDM-TDMA/SA MAC Protocol with QoS Constraints for Broadband Wireless LANs," ACM/Baltzer Wireless Networks, Vol.12 No.2, pp.159-170, April 2006.
3. W. Xiang, T. Pratt and X. Wang, "A software radio testbed for two-transmitter two-receiver space-time coding OFDM wireless LAN," IEEE Communication Magazine, vol. 42, pp.S20- S28, June 2004
4. W. Xiang, D. Waters, T. Pratt, J. Barry and B. Walkenhorst, "Implementation and experimental results of a three transmitter three-receiver OFDM/BLAST testbed," IEEE Communication Magazine, vol. 42, pp.88-95, December 2004
5. W. Xiang, P. Richardson, B. Walkenhorst, X. Wang and T. Pratt, "A high-speed four-transmitter four-receiver MIMO OFDM testbed: experiment results and analyses," EURASIP Journal of Applied Signal Processing, April, 2006.
6. T. Jiang and W. Xiang, "On nonlinear companding transformation for PAPR in OFDM systems," to appear in the IEEE Trans. on Wireless Communications
7. W. Xiang, "***An invited paper***: Introduction and preliminary research on wireless access for vehicular environments technology," V2VCOM, San Jose, California, July, 2006