The European Union directive 2010/40/EU defines the Intelligent Transport System (ITS) as a system with advanced applications which, without embodying intelligence as such, aims to improve transport management by increasing coordination and flow of information between on-road vehicles. It has also been envisaged that the application of information and communication technologies (ICT) in the transport sector has a key role in improving efficiency, safety, public security, and freight mobility management of a transportation system. Keeping in view the contribution made by ICT in realizing ITS, the authors have explored the communication mechanism between vehicles to enable various infotainment services.

This book is a result of 3 years of doctoral research focusing on one important aspect of Intelligent Transportation System: the roadside to vehicle (R2V) communications. This research work specifically explores the use of IEEE 802.11 technologies in the R2V scenario. The outcome of this research is also highly relevant in those situations where roadside 802.11 APs are specifically deployed for R2V communications.

Ever since their introduction in the late 1990s, WLAN APs have seen massive deployment across most modern cities. The idea of using already available indoor APs in outdoor vehicular environments has recently come under scrutiny. Although WLAN APs exist in large numbers alongside roads in most developed cities, the placement of these APs is highly unplanned. These WLAN APs cannot support continuous connectivity over a large mobility domain due to their unplanned deployment. Consequently, the network services offered by WLANs are disrupted when used in vehicular environments. While various research works are focused on disruption tolerant networking, this book develops and explores a completely new research direction—developing stochastic models of disruption in 802.11 WLANs and their implications on the vehicular communication systems. Second, a vehicle spends very little time within the AP footprint, most of which is consumed in handing over to the AP. Because of the small outdoor coverage region of the AP and the high speed of the vehicle, handovers inevitably occur frequently. The delay in handing over to these APs is termed as handover latency.
In order to achieve smoother transitions between the APs, the handover latency must be reduced. This book analyzes the latency by measuring various delays incurred during handovers.

This book is written for both mature and early stage researchers including postgraduate and doctoral students. Researchers from other fields interested in vehicular communications can also find this book interesting and informative. The detailed discussion on the prevailing research trends provided here will be useful for both doctoral and post doctoral researchers. This book would also be helpful in courses related to wireless networking since it covers the application of stochastic tools in analyzing communication networks in considerable detail.

The book comprises eight chapters. The basic concepts pertinent to IEEE 802.11 networks, vehicular communications, and challenges associated with 802.11-based vehicular communications have been discussed in Chap. 1. Chapter 2 provides a detailed review of previous research done in vehicular communications. More specifically, the works pertinent to disruption tolerant networking and handover latency have been reviewed. It also introduces some recent IEEE standards that are relevant in vehicular communication. Chapter 3 discusses the measurement results on parameters such as the signal strength and the data rates supported by the indoor APs in vehicular environments. A scheme for monitoring traffic congestion using the existing WLAN infrastructure has also been presented in this chapter.

Chapters 4–6 focus upon the analytical modeling of the disruption tolerant vehicular networks. Chapter 4 provides a 2-state and, next, a 3-state Markov model to compute the long-term error rate as a means of representing disruption. Chapter 5 modifies this model to hidden Markov model and introduces the probabilistic measures of disruption. Chapter 6 contains the application of the proposed model to quantify the benefits of using inter-operator roaming. Chapter 7 discusses the issues related with handovers in the vehicular context. Latency evaluations are provided at the beginning of the chapter followed by a description of the proposed channel scanning scheme to reduce scanning phase delay. The concluding remarks and future works are supplied in Chap. 8 while references and appendices are given at the end of this book.
Intelligent Transport Systems
802.11-based Roadside-to-Vehicle Communications
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2013, XX, 152 p., Hardcover