The land transportation systems have become crucial components of modern world. At one hand they are beneficial in terms of speedy transportation of goods and people, but on the other hand they are linked to an increasing number of road accidents worldwide. According to the world health organization (WHO) report in 2004, it is estimated that 1.2 million people die each year on the world’s roads and 50% of those are vulnerable road users, i.e., 23% motorcyclists, 22% pedestrian and 5% cyclist.

Nowadays, as more and more computerized systems and technologies are becoming part of our vehicles, and it is anticipated that these systems and technologies can be used to reduce accident and make traffic more efficient. An example of such system is intelligent transportation systems (ITS); the systems, which rely on cooperative communication, in general, and networking, in particular, among vehicles thus have the potential to ensure on-road safety, driving comfort and traffic efficiency. Following two main paradigms enable cooperative communications in the connected vehicle domain: First, infrastructure assisted, i.e., vehicle-to-infrastructure (V2I) communications; and second, ad-hoc multi-hop broadcasting, i.e., vehicle-to-vehicle (V2V) communications. However, a hybrid approach where both V2V and V2I can be utilized with respect to the ITS applications at hand. Multiple communication technologies and protocols such as IEEE 802.11p (dedicated for short range communication at 5.9 GHz), 3G and LTE are envisioned to be the base technologies for ITS systems.

For the safety related applications, V2V communication is more suitable candidate. It allows vehicles to communicate directly with minimal latency. The primary objective with the message exchange is to improve active on-road safety and situation awareness, e.g., collision avoidance, traffic re-routing, navigation, etc. The reliability of V2V safety applications, which use IEEE 802.11p as the underlying communication technology, highly depends on the quality of the communication link, which relies upon the properties of the propagation channel. It is the channel that determines the ultimate performance limits of any communication system.

The propagation channel in V2V networks is significantly different from that in cellular networks and thus the results from cellular channel research are not directly applicable to V2V channels. V2V employs an ad-hoc network topology, both transmitter (TX) and receiver (RX) are highly mobile, and TX/RX antennas are situated on approximately the same height and close to the ground level, implying that the V2V channel is more dynamic and non-stationary. Thus, to develop an efficient and reliable system a deep understanding of V2V channel characteristics is required.

In this thesis a measurement based characterization and modeling of V2V channel is presented in order to gain a deeper understanding about the channels for an optimum V2V system design. Measurement based analysis is performed in three steps: First, collection of data by means of real channel measurements, second, channel characterization by analyzing metrics like received power, signal fading, and signal dispersion in time and frequency, directional properties, and antenna properties in order to
understand key figures of merits, and third, modeling the channel such that the certain properties of the channel can be reproduced for system simulation and testing.

In summary, this thesis describes the channel behavior for safety-critical scenarios by statistical means and models it so that the system performance can be assessed in a realistic manner. In addition to that the influence of different antenna arrangements has also been studied to exploit the spatial diversity and to mitigate the shadowing effects. The presented work can thus enable more efficient design of future V2V communication systems.