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Improving Connectivity to Road Side Communication Units Using Steerable Directional Antennas in Vehicular Applications

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With pervasive computing and increasing use of Internet technology on one side and ever cheaper and better information and communication technology available on the other side, communication from a car to access points or road side communication units is becoming increasingly important and accepted. Different applications and value-added services are discussed for vehicular communications. Besides road safety applications, such as traffic and weather warnings, applications like tourist information and passenger entertainment are being studied.

For applications using wireless LAN based infrastructures, such as IEEE 802.11p/DSRC (Digital Short Range Communication) or IEEE 802.11a/b/g, instead of cellular networks for bandwidth or cost reasons, the duration of the connection to a single access point in particular when driving at higher speeds is an issue. Depending on business models and architectures investigated this WLAN infrastructure may be based on community networks or be commercially operated.

This paper presents results of experiments in vehicular communication using steerable beam directional antennas. These antennas have the ability to electronically orient a directional beam at any user specified angle. Using such a directional antenna on a moving vehicle, the duration of connection to a fixed access point or a road side communication unit can be extended. In addition interference is reduced due to directional transmission. Directive antennas can furthermore be used to localize either the fixed or the mobile station.

In this work results of experiments with directional antennas mounted on a car communicating with stationary access points are presented. The measurements show the benefit of using directional antennas in different environments typical for vehicular communications. The duration and the throughput of 802.11b connections have been compared using directional and omnidirectional antenna patterns when driving through suburban environment.

Two sets of experiments have been performed. The first experiments have been performed using a dedicated access point in a controlled environment and the above mentioned directive antenna on the car. The results show both an improvement in range and an improvement on achievable data rate.

The second set of experiments is based on scanning for access points in different typical suburban environments in order to validate the approach in realistic scenarios. The results clearly prove a substantial improvement when using directional antennas: the connection duration as well as the number of access points in communication range increase using directional antennas.

In the paper application scenarios in vehicular communications are introduced and the experiments and the results of the experiments performed are highlighted.