On Implementation of TPMS receiver for Traffic Data Collection

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Tire Pressure Monitoring System (TPMS) is an electronic system used for monitoring air pressure inside pneumatic tires. TPMS consists of controlling unit (CU) placed inside vehicle, and wireless sensors installed in every tire. The CU and TPMS sensors are connected via radio link. Therefore, the wireless activity of TPMS sensors can be utilized for traffic detection purposes by receiving TPMS signals externally and extracting their information (unique ID). This information can be used then for identification and re-identification of the vehicles, and consequently for calculation of travel times and other important traffic parameters. The initial idea has already been described in our previous publications. In this paper we present a prototype receiver of TPMS signals, as well as the initial results from the field experiments regarding received signal strength (RSS) and packet error rate (PER), in both dynamic and stationary case.

There are various types of commercially available TPMS sensors and they mostly differ in: modulation type, bit rate and frame format. In order to discover those parameters, we performed reverse engineering on seven different TPMS sensors and prototyped a TPMS receiver. For accomplishing this, we have used Software Defined Radio (SDR) approach since it provides the highest flexibility. Universal Software Radio Peripheral (USRP1) from Ettus Research is used as a radio frontend, while GNURadio framework is used on the computer side for baseband signal processing.

Our initial experiments have been performed on the test track in Berlin. Two prototype receivers, equipped with directional antennas, were mounted on the gantries at both ends of the track. The achieved reception range was approximately 100 m. Using the information, extracted from TPMS signals, we were able to derive travel times between two points, which has proven the basic concept of utilizing TPMS for traffic detection. As for the further investigations, it is planned to perform field experiments for measuring RSS for different velocity and distance values. In this way we will be able to investigate the dynamic fluctuations of the received signal and to estimate its dynamic range.