Usage of SDR to Decode Tire Pressure Monitoring System (TPMS)

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*Abstract*— This project describes a successful design and implement for a generic tire pressure monitoring receiver using a software defined radio (SDR) module (Nooelec NESDR Mini SDR & DVB-T USB Stick) and MATLAB. The scope of the project investigates frequency modulation schemes and data coding used in vehicles’ tire pressure monitoring systems (TPMSs), implementation of a TPMS receiver as a proof of concept, and evaluation of this concept by deploying the TPMS for data capture. A security risk assessment was also performed to evaluate the security of TPMS usage.

Index Terms: XX, XX, XX, and XXX

**Background**

Maintaining the tires’ designed operating pressure is imperative to safety and fuel economy. Most modern cars are equipped with a TPMS which consists of tiny battery-powered wireless sensors mounted in the vehicle’s wheels and a base station embedded in the car’s control system. The tire pressure information collected by the sensors is wirelessly transmitted to the base station and displayed on the vehicle’s dashboard. TPMSs typically transmit on license free bands, such as 315 MHz, which can easily be received by an SDR module [1]. However, this raises security concerns: since the TPMS transmits over radio link, hackers can snoop the communications and send false tire pressure readings to motorists, which may reduce safety margins and increase the chance of a tire blowout [2].

Prior works have shown that TPMS communication interceptors can be built using advanced SDR devices such as the Universal Serial Radio Peripheral (USRP) receiver and trigger, which costs approximatively $2,000, or using a combination of a radio frequency (RF)-front end integrated circuit, microcontroller, and a demodulation circuit, averaging approximately $500 [3, 4]. Further findings have also demonstrated that TPMSs lack rigorous security and represent one of the entry points for automotive cyberattacks [5]. While these threats were validated in controlled lab environments, researchers have not proved that TPMS data can be captured while the vehicle is in motion at different speeds. Hence, sensor node mobility is yet to be considered, but is required to fully substantiate TPMS security threat concerns.

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*a**b* 

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* The word “data” is plural, not singular.
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* There is no period after the “et” in the Latin abbreviation “et al.”.
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##### References

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1. G. Eason, B. Noble, and I. N. Sneddon, “On certain integrals of Lipschitz-Hankel type involving products of Bessel functions,” Phil. Trans. Roy. Soc. London, vol. A247, pp. 529–551, April 1955. *(references)*
2. J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68–73.
3. I. S. Jacobs and C. P. Bean, “Fine particles, thin films and exchange anisotropy,” in Magnetism, vol. III, G. T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271–350.
4. K. Elissa, “Title of paper if known,” unpublished.
5. R. Nicole, “Title of paper with only first word capitalized,” J. Name Stand. Abbrev., in press.
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7. M. Young, The Technical Writer’s Handbook. Mill Valley, CA: University Science, 1989.

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