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Multi-technology RF fingerprinting with leaky-feeder in underground tunnels

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ABSTRACT

Location fingerprinting methods have received significant attention among indoor location methods and been successfully applied in a wide range of scenarios due to their flexibility and simple principle of operation. Nevertheless, the accuracy obtained with these methods is highly dependent on the type of underlying radio network and on the specific environment characteristics that determine the signal propagation conditions. In the case of underground tunnels whose network coverage is implemented over leaky-feeders, the relatively low attenuation of the signal along the cable can be obfuscated by fluctuations occurring in the short-range due to *fast-fading* and signal coupling phenomena, thus yielding very often unsatisfactory results.

To improve the accuracy in these scenarios, a new method taking advantage of multiple network technologies deployed in the tunnel of CERN's Large Hadron Collider (LHC) is being investigated. This paper describes how the Received Signal Strength (RSS) from different networks available to the same area can be measured and used to determine position, and how the strategic coupling of a signal into the leaky-feeder can influence the resulting accuracy.

The study comprises the measurement of the signal from the existing GSM network as well as from a Wireless LAN signal coupled into the leaky feeder cable via a set of high gain antennas at different points. Additionally, 3G (UMTS) signal, which will progressively be implemented in the LHC tunnel, will be taken into account. Furthermore, to help minimizing the impact of fast-fading effects, special attention in the calibration process has been given towards the uniformity of the measuring conditions, including a precisely defined distance to the cable.

The study is currently ongoing, with results expected to be available for inclusion in the full paper. They shall comprise a characterization of the *radiomap* from each network as well as the improvement on the accuracy as additional signals are taken into account. Moreover, a description of the impact in accuracy resulting from changing the injection point of the WLAN signal is also expected to be included.

In the end some conclusions explaining some of the observed facts are provided as well as a brief outlook of future work.

KEYWORDS: fingerprinting, multi-technology, leaky-feeder, gsm