

# Enabling Location-based Applications through Integration of WSNs and Smart Phones

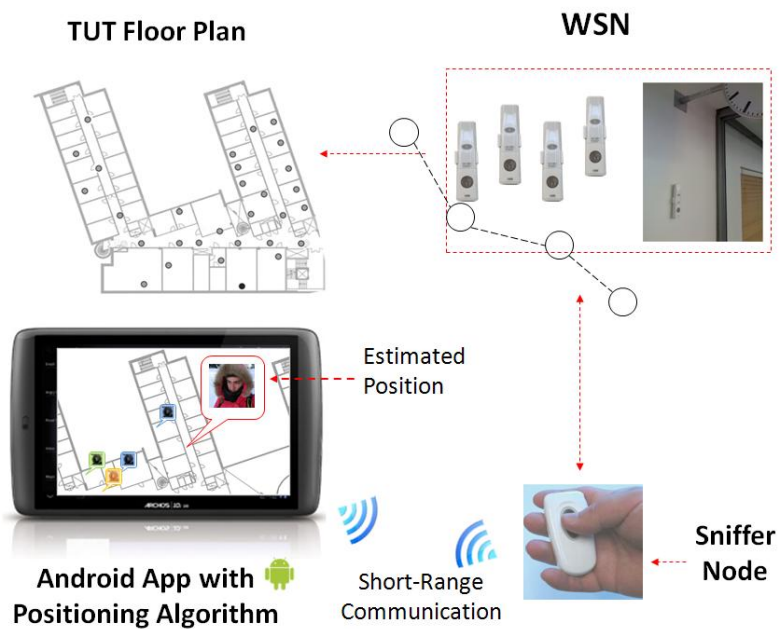
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## ABSTRACT

This paper presents a novel indoor positioning framework developed at Tampere University of Technology (TUT) targeting at mass market. The framework integrates Wireless Sensor Networks (WSN) and smartphones for data acquisition and positioning processing, short-range communications, and user applications. Specifically, the authors introduce the technical design of a WSN and Android devices integration in campus-wide pilot deployments (Fig.1) defined by: 1) Fixed/mobile location WSN nodes communicating in the 2.4 GHz frequency band; 2) Portable WSN sniffer nodes; 3) Location-based App exploiting short-range communications with the latter. The main objective of the work is a proof-of-concept to drive location-based research towards real-life applications while ensuring sustainable competitiveness of mass market requirements. The system stands out from the competition by offering a straightforward integration among WSNs and smartphones, together with a simple, scalable, and reliable indoor positioning solution so pervasive and affordable to become a default feature for existing populated indoor environments, like shopping mall, museums and university campuses. The WSN developed in the proof-of-concept deployment is nowadays fully autonomous, with a network coverage and reliability strengthened by dynamic multihop routing. An energy-optimized protocol stack enables adding new wireless nodes freely and additional context to positioning services enabling social features. In the deployment, a passive WSN sniffer node, placed in the user's pocket, scans the WSN environment while delivering results to the smartphone using Bluetooth. The phone calculates the position of the user through a twofold positioning algorithm: either processed by a central server or by the device itself. The algorithm is based on an hybrid cell-id/triangulation concept augmented through a node priority ranking procedure where, the transmission power of the beacons is rotated between different levels, allowing room-level localization. The positioning does not require any fingerprinting of signal strengths neither pathloss models, which is crucial for easy deployments of the concept.

**KEYWORDS:** WSN, Location-Based Services, Indoor Positioning, Hybrid Technologies.



**Figure 1 WSN / Android App Integration**