

Abstract

A Wireless Body Area Network (WBAN) consists of resource-constrained, lightweight, miniaturized, and wearable sensor devices such as ECG sensor, pulse oximeter, body temperature sensor, S_pO_2 sensor, and accelerometer, which are responsible for measuring intended physiological parameters. The measured data are transmitted via wireless channel to a local coordinating unit for aggregation. After initial processing, the aggregated data are sent to external medical servers for medical analysis, with the help of Wi-Fi or cellular networks, in general. In this thesis, we address different issues of wireless communication arising between the sensor devices and the coordinating unit.

QoS provisioning, along with various effective measures to improve the QoS of a WBAN, is the primary goal of this thesis. In this regard, the fundamental approach that is proposed in the contributing Chapters, is priority-based QoS provisioning in WBANs. We prioritize the associated sensor devices based on WBAN-specific attributes, among which health severity plays a significant role. The quantification of health-severity is an elementary research challenge, as the WBANs primarily deal with health monitoring of the end-users. Moreover, the consideration of other network-specific attributes that influence the QoS of a network and utility formulation are other important aspects in this light. Subsequently, more specific treatment on the medium access mechanism is identified as a key challenge in order to achieve improved QoS.

In this thesis, we envision a fuzzy inference-based approach to quantify health severity corresponding to each sensor device. We exploit this attribute throughout the works discussed in this thesis, and analyze its influence on QoS. We also use the concept of utility formation and envision the problem of resource sharing among the sensor devices as a cooperative bargaining game. The corresponding results explain the mutual benefits achieved by the cooperation among the sensor devices. Moreover, rigorous analysis of the MAC protocol of IEEE 802.15.4 standard is performed to maximize data transmission reliability, which is an essential QoS attribute. The necessity of achieving trade-off between performance metrics, in order to maintain QoS in the presence of contradictory demands, is also discussed in detail.

Keywords: Wireless Body Area Network, QoS Provisioning, Data-rate Tuning, Payload Tuning, Ubiquitous Health Monitoring, e-Health, m-Health.