UNIVERSITY OF TECHNOLOGY SYDNEY

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DEVELOPMENT OF EFFICIENT MEDIUM ACCESS CONTROL PROTOCOLS FOR WIRELESS BODY AREA NETWORKS

by

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Declaration

I certify that, to the best of my knowledge, the dissertation in this thesis has not previously been submitted for a degree nor as part of requirements for a degree except where otherwise acknowledged within the text.

All sentences quoted in this thesis from other work have been specifically indicated by clear cross-referencing. I understand that failure to do this is plagiarism.

Sarvin Sadra

Abstract

Future healthcare systems aim to provide smart, unobtrusive, unconstrained, pervasive and proactive healthcare through affordable and accessible means. A key enabler towards achieving the above is through solutions, which provide timely and continuous monitoring and analysis of physiological parameters of the body. The parameters obtained through the remote monitoring systems are used to analyse, diagnose and develop treatments. This allows for early detection of symptoms or abnormalities and in turn, prevention of illnesses.

Wireless Body Area Networks (WBANs) are an essential part of future healthcare systems with the potential to seamlessly interconnect wearable and implantable sensors. In recent years, WBANs are expected to support various types of applications with datarates from a few Kbps up to 15 Mbps and satisfy heterogeneous requirements of both medical and consumer electronics.

WBANs have captured the attention of researchers and motivated them to develop strategies that can enable them to handle various types of applications. Unfortunately, existing wireless networks cannot meet the strict Quality of Service (QoS) requirements of these networks. Hence, novel communication protocols considering the limitations of these networks need to be developed to pave the way for optimum network efficiency and data transmission reliability.

The Medium Access Control (MAC) protocols have an important role in supporting the combination of reliability, quality of service, energy efficiency and scalability. The current IEEE 802.15.6 MAC protocol based on the latest WBANs standard is not optimised to maintain a balance between the energy limitation and QoS requirements for the diverse range of applications. Consequently, new research is required to explore the above issue and develop new enhancements for the IEEE 802.15.6 standard to better manage different applications over different conditions and scenarios better.

This research focuses on developing MAC protocols to improve the performance of WBANs specifically in the saturation condition. As in saturated networks all the nodes send packets continuously, high level of collisions occurs and the medium is poorly utilised. While the high percentage of the packets of the highest user priority are dropped which carries life-critical information, other user priorities are not able to access the medium. To this extent, this research considers these challenges to improve the network performance in saturated networking condition both for the highest user priority and the other user priorities at the same time.

Two IEEE 802.15.6-based MAC protocols, Saturation Aware for the User Priorities (SAUP) and Saturation Aware for the Highest User Priority (SAH) MAC protocols have been proposed to address these shortcomings for all the user priorities and enhance the channel access for different user/application priorities in saturated networks.

The simulations were performed in the MATLAB framework. The results indicate the proposed protocols achieve better network performance as well as reducing energy consumption compared to the IEEE 802.15.6 MAC protocol. The improvements in the network performance and energy efficiency are specificity, for the user priorities other than the highest one in the proposed SAUP MAC protocol. However, SAH proposed MAC protocol focuses on the network improvements for the highest user priority comparing with IEEE 802.15.6 MAC protocol in the saturated WBANs.

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Publications

1. S. Sadra, M. Abolhasan, ”On Improving the Saturation Performance of IEEE 802.15.6-based MAC Protocols in Wireless Body Area Networks”, the 13th International Wireless Communications and Mobile Computing Conference (IEEE IWCMC), 2017.

2. S. Sadra, M. Abolhasan, ”On Developments of MAC Protocols for Wireless Body Area Networks”, To be submitted to the Journal of Networks, 2017.

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