A New Zigbee Backoff Approach for Home Healthcare Devices

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***Abstract*—Most of Healthcare Monitoring System (HMS) used ZigBee, one of the Wireless Sensor Network technologies that offer better mobility, low power consumption and better network scalability. However, ZigBee-based devices face overlapping channel with Wi-Fi devices which cause interference when deployed under the same operating frequency. In this paper, we proposed a new ZigBee algorithm based on Carrier Sense Multiple Access with Collision Avoidance (CSMA-CA) to minimize the Wi-Fi interference using experimental approach. Further elaboration highlights the approach, experiment set-up and the analysis metrics for the ZigBee and Wi-Fi coexistence issues. By minimizing the effect of Wi-Fi interference, it will improve the ZigBee transmission reliability which critically required for developing a reliability HMS application. A fragmentation packet management can be considered in the future development to improve packet allocation for large type packet to avoid collision with Wi-Fi packets for better HMS application performance.**

***Index Terms*—ZigBee; MicaZ; Coexistence; CSMA-CA; Smart Home; Healthcare Monitoring.**

I. INTRODUCTION

Health Monitoring System (HMS) is one type of medical system used in healthcare application today to monitor patient health parameters to improve their health condition. HMS goals to facilitate medical application in increasing monitoring accuracy, produce high quality of monitoring data, and less medication error [1]. Besides, HMS deployment also not limit to the medical center or hospital only. It can be deployed in multiple environments like home, and outdoor environments allow patient for self-monitoring that give an advantage for people that live alone. For example, Smart Home introduced as home environment indoor health and safety automated monitoring solution that targeted in assisting elderly and disabled people as stated in [1]. It also aids the medical team in early disease detection as the patients are continuously monitored 24/7 in their home. While for an outdoor solution, HMS can be integrated as part of Smart City that also assists elderly and disabled peoples in the case of emergency that happens within the Smart City network.

As mentioned before, HMS can be used to facilitate medical application as a modern Health Monitoring System is mostly computerized health parameters observation and acquisition for health diagnosis. Data acquisition achieved by using smart monitoring device approach in the form of wearable and remotely monitoring devices to collect patients' health parameters [1]. The health parameters are fetched automatically from the patient without any human intervention. The information fetched is accumulated digitally in local or online data repositories for diagnosis and research purposes. Patient common measured health parameters are heart rate, body temperature, blood pressure, etc. In HMS, those parameters are important because each of the parameters can be related to each other. For example, the system [2] proposed is more for elderly fall detection which elderly heart rate and body position parameter are crucial to being measured. Fall detection depends on those two parameters where a sudden changed of body position with increasing of heart rate can be predict as falling and caused an emergency alert to be triggered to the caretaker.

Health parameters in HMS are also monitored in real time fashion. This is to prevent outlier and to obtain reliable results [4]. Continuity and accuracy in data acquisition are fundamental issues for real-time monitoring. It requires a reliable communication system. Basically, in HMS, sensor node is used to obtain data and sink node is for processing data. Communications between nodes is done via wirelessly which to provides mobility to the monitored patient or users.

ZigBee is a Wireless Body Area Network (WBAN) technology. It has small size of data transfer, low power consumption time and better network scalability which is suited for the medical application. Zigbee is a protocol with used IEEE 802.15.4 as its baseline and implemented on low powered devices manufactured by various manufacturer [15]. ZigBee supports 250 Kbps theoretical bandwidth which makes it suitable technology in sending smaller data. Moreover, ZigBee devices are capable running time up to 17 months with optimized power configurations which is less cost for power maintenance. It also provides better network scalability due to it Mesh Network capability where the ZigBee device able to detect the present of new sensor nodes and reroute data from an origin node to the sink node. Those three important features of ZigBee make it suitable for HMS application based.

Despite the aforementioned advantages, ZigBee is subject to interference from the overlapping operating channel with Wi-Fi devices which also used 2.4 GHz bands [12,14]. Most of the Wi-Fi router or device has a power range from 5-20 dB which is higher than the ZigBee maximum transmission power (0 dB). A high Wi-Fi transmission power can give serious impact on ZigBee device performance which affects the reliability of the ZigBee communication when overlapping channel occurs. In recent studies, when ZigBee network deployed in the area with moderate Wi-Fi traffic it can cause packet delivery delay problem due to high jitter time [5,6,11]. Moreover, different way of deploying CSMA-CA protocols with the different back off duration also potentially lead to significant performance depreciate for