PERFORMANCE OF EMERGENCY PACKET HANDLING MECHANISM FOR WIRELESS BODY AREA NETWORKS

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Abstract- To analyze and design an efficient transmission control mechanisms for handling critical and non-critical data in wireless body area network, we propose a packet handling mechanism in order to handle the emergency packet. In this paper the performance of emergency packet handling is compared with the existing technique and the simulation results show that the proposed protocol improves the throughput while reducing the delay and energy consumption.

Keywords- Emergency Tone, McMAC, QOS, WBAN

I. INTRODUCTION

During the last few years there has been a significant increase in the usage of Wireless Body area Networks (WBAN) and use of the Internet for healthcare to mobile applications. WBAN is one of the most promising approaches in building wearable health monitoring systems. WBAN consists of multiple sensor nodes, each capable of sampling, processing, and communicating one or more vital signs (i.e. heart rate, blood pressure, oxygen saturation, activity) or environmental parameters (i.e. location, temperature, humidity, light). Typically, these sensors are placed strategically on the human body as tiny patches or hidden in user’s clothes allowing ubiquitous health monitoring in their native environment for extended periods of time.

II. RELATED WORKS

IEEE 802.15.4 is a low-power protocol designed for low data rate applications. It offers three operational frequency bands: 868 MHz, 915 MHz, and 2.4 GHz bands. There are 27 sub-channels allocated in IEEE 802.15.4, i.e., 16 sub-channels in 2.4 GHz band, 10 sub-channels in 915 MHz band and one sub-channel in the 868 MHz band. In recent years most of the works that are related in traffic are BodyMAC, TaMac, Ada-MAC. Further to these work Muhammad Mostafa Monowar et al., have proposed McMAC, a novel emergency packet handling mechanism is proposed to ensure packet delivery with the least possible delay and the highest reliability. In this paper they have proposed a protocol but how to handle the QOS support is not well-defined.

The BodyQoS algorithm by et al., separates QoS scheduler from the underlying MAC implementation. Though it does not suffer from the limited number of GTSs, high priority applications are blocked by low priority applications due to the adaptive of non-preemptive slot allocation schemes.

ATLAS proposes a traffic load aware MAC protocol where the superframe structure varies based on the estimated traffic load and uses a multihop communication pattern. But it does not take the priority of different applications into account. There is also no indication of backoff class depending on the priority to avoid collision and to let higher priority application request first. Also, managing four types of adaptive superframe structure depending on traffic load may become a computational load on the gateway.

A dedicated adaptive wireless protocol should be designed for WBAN to accommodate critical and non critical data in the same platform with low latency and information loss probability. In this paper, each received packet is verified to determine whether it is normal packet or emergency packet. If the packet is emergency packet, then emergency tone is sent to alter the traffic and the packets are then sent without any waiting by using the emergency packet handling mechanism of MAC protocol.

III. EMERGENCY PACKET HANDLING MECHANISM

Emergency packets transmitted when the life-critical situation occurs and it has highest priority among the all the traffic nodes. These are transmitted first among the traffic. Life-critical situation means, when the heartbeat rate of a patient exceeds a certain threshold, an emergency action is needed, which thereby requires instantaneous transmission with the highest reliability. This traffic is highly QoS-constrained in terms of both delay and reliability.

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I. Algorithm for packet handling mechanism

Start
Define CN = Center Node
If (data packet is emergency packet)
    { An emergency tone is send by CN to alter the nodes in traffic
      Set the data packets priority high
      Send the data packets immediately without waiting
    }
Else
    { Set the priority using priority table
      Send the packet through normal packet traffic flow
    }
End

In the algorithm (1), Central node is observing the data traffic. If CN, received emergency data packets then emergency tone send to the data traffic to alter the other data packets. CN send the emergency packet without delay.

The transmission of this emergency packet must be done instantaneously to satisfy the extensive delay-sensitive requirement, because waiting of emergency packet made it invalidate or useless. The emergency packets do not switch to wait mode in any situation.

A. Reliability modelling analysis
The probability P of successful contention in a single emergency time slot is calculated using the following equation

\[ P = \left(1 - \frac{1}{n_p}\right)^{n_p-1} \quad (1) \]

where \( n_p \) be the number of nodes present having emergency traffic during a particular period.

Assume \( j \) is the maximum number of attempts for successful transmission. The probability of successful transmission \( P_{ST} \) can be formulated as

\[ P_{ST} = \sum_{k=1}^{j} P(1 - P)^{k-1} \quad (2) \]

B. Delay modelling analysis
The expected delay \( D_e \) for emergency traffic during contention access period is calculated using the following equation

\[ D_e = T_w + (j-1)(E_{TR} + E_p) + E_p + 3E_p + E_{DT} \quad (3) \]

The average waiting period until a node to transmit the emergency packet is denoted as \( T_w \), \( j \) is the number of attempts required to successfully transmit the emergency packet, \( E_{TR} \) is the emergency tone reception time, \( E_D \) is the emergency data packet transmission time and \( E_p \) is the packet length. Because the structure of the regular packet is the same as that of the emergency packet, the same notation \( E_p \) is used for both packets in this equation.

IV. SIMULATION
A. Simulation setup
The performance is evaluated using NS2 simulation. A network area of 50 X 50 m is considered. The IEEE 802.15.4 MAC layer is used for a reliable and single hop communication among the devices, providing access to the physical channel for all types of transmissions and appropriate security mechanisms. The IEEE 802.15.4 specification supports two PHY options based on direct sequence spread spectrum (DSSS), which allows the use of low-cost digital IC realizations. The PHY adopts the same basic frame structure for low-duty-cycle low-power operation, except that the two PHYs adopt different frequency bands: low-band (868/915 MHz) and high band (2.4 GHz). The PHY layer uses a common frame structure, containing a 32-bit preamble, a frame length.

<table>
<thead>
<tr>
<th>Table I: Simulation Parameters</th>
</tr>
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<tbody>
<tr>
<td>No. of Nodes</td>
</tr>
<tr>
<td>Area Size</td>
</tr>
<tr>
<td>MAC</td>
</tr>
<tr>
<td>Transmission Range</td>
</tr>
<tr>
<td>Routing Protocol</td>
</tr>
<tr>
<td>Traffic Source</td>
</tr>
<tr>
<td>Packet Size</td>
</tr>
<tr>
<td>Rate</td>
</tr>
<tr>
<td>Simulation Time</td>
</tr>
</tbody>
</table>
B. Simulation results

The performance of TPMAC is compared with the McMAC scheme. The performance is evaluated based on rate mainly according to the delay, throughput and energy consumption. The simulation results of WBAN techniques are summarized in the Table II. The end-to-end-delay is averaged over all surviving data packets from the sources to the destinations. The number of packets received by the receiver is the throughput. Energy consumption is the average energy consumption of nodes during the transmission.

Case-1 (CBR Scenario) Based on Rate

![Graph showing Rate Vs Delay(CBR) comparison between TPMAC and McMAC]

![Graph showing Rate Vs Throughput(CBR) comparison between TPMAC and McMAC]

Table II: Comparative analysis of WBAN techniques

<table>
<thead>
<tr>
<th>Performance Metric (Based on Rate)</th>
<th>Techniques</th>
<th>Improved Performance (in %)</th>
<th>Observation (over existing schemes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBR</td>
<td>McMAC</td>
<td>TPMAC</td>
<td></td>
</tr>
<tr>
<td>Delay (in sec)</td>
<td>18.163</td>
<td>2.398</td>
<td>86%</td>
</tr>
<tr>
<td>Throughput (No of packets/s)</td>
<td>4</td>
<td>835</td>
<td>99%</td>
</tr>
<tr>
<td>Energy consumption (in J)</td>
<td>9.143</td>
<td>9.434</td>
<td>1.12%</td>
</tr>
</tbody>
</table>

The delay is observed for the simulated traffic for the two different techniques with different rate scenario. The delay for McMAC is 18.163 Kb whereas 2.398 Kb is achieved for TPMAC. From the results it is evident that the delay is decreased by 86% over the existing schemes.

The throughput of CBR is higher than the existing. Finally the energy consumption of TPMAC is 9.434 J and 9.543 J is for McMAC. Also, the decrease in energy by less than 2% shows that the technique consumes low power.

**CONCLUSION**

In this paper, the performance of emergency packet handling mechanism in wireless body area networks is compared with the existing technique. The simulated traffic based on the rate for CBR source is performed for delay, throughput and energy consumption. The comparative result shows that the energy consumption is reduced by 2%. Further to this study the traffic priority can be assigned to handle the emergency packet to improvise the performance.

**REFERENCES**


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