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Enhanced and Efficient Routing in WBAN

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Abstract: This paper modifies the link aware routing protocol to enhance the performance of the protocol. In the link aware protocol eight sensor nodes are deployed on a human body; having equal power and computation capabilities. Sink node is placed at waist. Different nodes are used to measure various activities. In the existing protocol all the nodes are active at every time, but the total usage period of few nodes is very less depending upon the disease covered. This leads to the wastage of the energy. This work uses the Sleep state to save the energy. The sink node will remain active all the times and the other node are in the sleep state. The node which gets selected for the transmission will change its state to the active state; other nodes will remain in the sleep state. The simulation results show that the proposed technique is better than the existing technique.

Keywords: WBAN, PDR, active, BNC, LAEEBA.

I. INTRODUCTION

A WBAN consists of several sensors and possibly actuators equipped with a radio interface. Each WBAN has a sink or personal server such as a PDA, that receives all information from the sensors and provides an interface towards other networks or medical staff. Connecting health monitoring sensors wirelessly improves comfort for patients but induces a number of technical challenges like coping with mobility and the need for increased reliability. The main use of sensor networks can be found in the area of wearable health monitoring. Carefully placing sensors on the human body and wirelessly connecting them to monitor physiological parameters like heartbeat, body temperature, motion et cetera is a promising evolution. This system can reduce the enormous costs of patients in hospitals as monitoring can occur real-time, over a longer period and at home. An important requirement in WBANs is the energy efficiency of the system. The sensors placed on the body only have limited battery capacity or can scavenge only a limited amount of energy from their environment. Consequently, in order to increase the lifetime of the network, energy efficient measures needs to be taken. From that point of view, several researchers are developing low power sensors and radios. Another possibility is the design of optimized network protocols to lower the energy consumption while satisfying the other requirements [1].

II. WBAN ARCHITECTURE

Figure 1 shows secure 3-level WBAN architecture for medical and non-medical applications. Level 1 contains in-body and on-body BAN Nodes (BNs) such as Electrocardiogram (ECG) – used to monitor electrical activity of heart, Oxygen saturation sensor (SpO2) –used to measure the level of oxygen, and Electromyography (EMG) – used to monitor muscle activity [2].

Level 2 contains a BAN Network Coordinator (BNC) that gathers patient's vital information from the BNs and communicates with the base-station. Level 3 contains a number of remote base-stations that keep patient's medical/non-medical records and provides relevant (diagnostic) recommendations. The traffic is categorized into on demand, emergency, and normal traffic. On-demand traffic is initiated by the BNC to acquire certain information. Emergency traffic is initiated by the BNs when they exceed a predefined threshold. Normal traffic is the data traffic in a normal condition with no time critical and on-demand events.

The normal data is collected and processed by the BNC. The BNC contains a wakeup circuit, a main radio, and a security circuit, all of them connected to a data interface. The wakeup circuit is used to accommodate on-demand and emergency traffic. The security circuit is used to prevent malicious interaction with a WBAN.

III. EXISTING ROUTER

The limited number of nodes in a WBAN environment gives us an opportunity to relax constraints in routing protocols. Considering these constrains in mind, existing have tried to improve the network life-time of the network; energy of the network as well as the path loss of the link being established between the nodes. The path selection is done in such a way that a path with minimum number of hops for data transmission, direct communication for emergency data and multi hop for normal data delivery. Thus, relay nodes can easily forward the received data to sink due to higher energy levels. Additionally, it analyzes their protocol for cross layer application in terms of path loss and network life-time.

A. System Model

In existing model, sink is placed at center of the human body. Since WBANs are heterogeneous networks, then placement of nodes on human body is an issue. Eight sensor nodes are deployed on a human body; having equal power and computation capabilities. Sink node is placed at waist. Node 1 is the sensor for detecting ECG while node 2 is the sensor for detecting Glucose. These two nodes transmit data directly to sink. Rests of the nodes are transmitting data to the sink through other nodes acting as relay. Figure 1 below shows the schematic diagram for existing protocol.

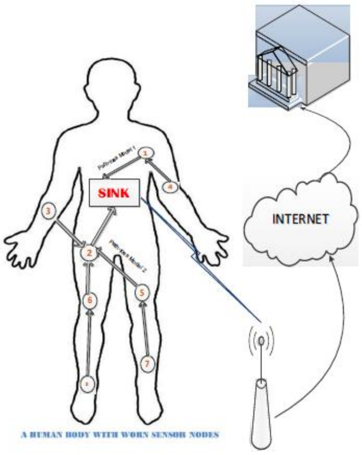

Figure 1: Schematic Diagram for LAEEBA Protocol

B. Initialization Phase

Three different types of tasks are performed in this phase; first each node is informed with its neighbors, the location of sink on the body is identified and all the possible routes to sink are also evaluated. The sensors update their location of neighbors and sink when each node broadcasts an information packet containing its node ID, its own location and its energy status.

C. Next-Hop Selection Phase

In this section, we present selection criteria for a node to become parent node or forwarder. To balance energy consumption among sensor nodes and to trim down energy consumption of network, LAEEBA protocol elects new forwarder in each round. The sink node knows the ID, distance and residual energy status of all its constituent nodes. It computes the cost function of all nodes and transmits this value to all members. On its basis, each node decides whether to become a forwarder node or not. If i is number of nodes than cost function c(i) of i nodes is computed as follows:

$$C_i = \frac{\sqrt{d(i)}}{E(i)}$$

Where d(i) is the distance between the node i and sink, E(i) is the residual energy of node i and is calculated by subtracting the current energy of node from its initial energy. A node with minimum cost function is preferred as a forwarder. All neighbor nodes then stick to the forwarder node and transmit their data to it. Forwarder node aggregates data and transfers to sink. This node has maximum residual energy and minimum distance to sink; therefore, it consumes minimum energy to forward data to sink. Nodes like 1 and 2 for ECG and Glucose monitoring communicate direct to sink and do not participate in forwarding data.

D. Routing Phase

Next-hop selection phase is followed by the routing phase. In this phase, such routes are selected which are at fewer hops to sink. As the nodes have information of all nodes and sinks location, so selected routes are steady fast and consume less energy. In critical scenarios, all processes are lagged until critical data is successfully received by sink node.

In case of emergency, all the implanted nodes on the body can communicate directly with the base station. In direct communication, delay is much lower as compared to Multihop communication, because in Multi-hop communication, each intermediate node receives processes and then sends data to next node. This causes delay and it is considerably increased due to congestion and becomes unacceptable in some critical scenarios. So, single-hop communication is used to minimize this delay.

Energy consumed in single-hop communication is:

$$E_{S-HOP} = E_{tx}$$

Where Etx is the transmission energy and can be computed as:

$$E_{tx} = b \times (E_{elec} + E_{amp}) \times d^2$$

Where Eamp is the energy needed for transmit amplifier upto a distance of d and packet size b. The energy consumption due to multi-hop communication is:

$$E_{M-HOP} = n \times b \times E_{tx} + (n-1) \times b \times (E_{rx} + E_{DA})$$

Where Erx is the energy required for reception, EDA is the energy consumption for data aggregation and n is the number of hops. Also it is assumed that Erx = Etx.

E. Path-loss Selection Phase

Human body is partially conductive by nature, and certain substances having varying thickness, characteristics of impedance and dielectric constants are embodied in it. High losses may occur in response to the communication protocol adopted for nodes, in subject to the operating frequency band. Many standards are in use for communication in WBASNs, at present like Bluetooth, ZigBee, MICS etc. When devices communicate, losses between them cause degradation in the performance of monitoring system.

Path loss includes all the consequences linked with distance and interaction of the propagating wave with physical objects in the environment between transmitter and receiver. Hence, it is the reduction in power density of an electromagnetic wave. In case of WBANs, path loss depends on distance and frequency.

IV. PROPOSED WORK

In the existing work all the nodes are active at every time, but the total usage period of few nodes is very less depending upon the disease covered. This leads to the wastage of the energy. This energy consumption can be reduced. The sensor node can be at sleep state or active state. The sleep state energy consumption is very less as compared to the active state. The sink node will remain active all the times and the other node are in the sleep state. The node which get selected for the transmission i.e. the parent node and the forwarder node will change its state to the active state, other nodes will remain in the sleep state. This procedure can be explained by the following flow diagram:

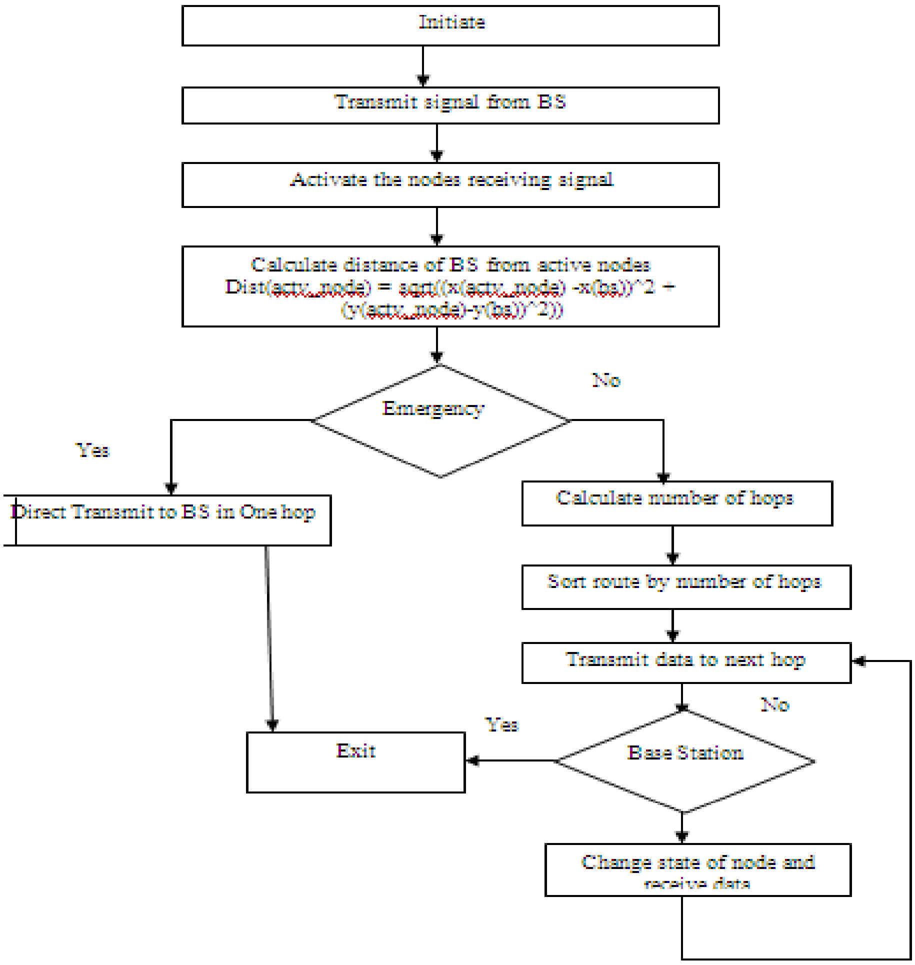

Figure 2: proposed Flowchart

In the initialization phase, the sink node gets the location and energy status of each node. The sink node changes the state of all sensors to the sleep state. The next hop selection phase selects the parent and the forwarder node. The state change phase changes the phase of the selected node to the active state. Then the routing and the path loss phase occur similar to the existing work. This work can be simulated using the NS2 explained in the next chapter.

V. IMPLEMENTATION

The paper implements the proposed protocol by using NS2.35 which is installed over ubuntu 12.04. The simulation is analyzed over different scenarios having different nodes.

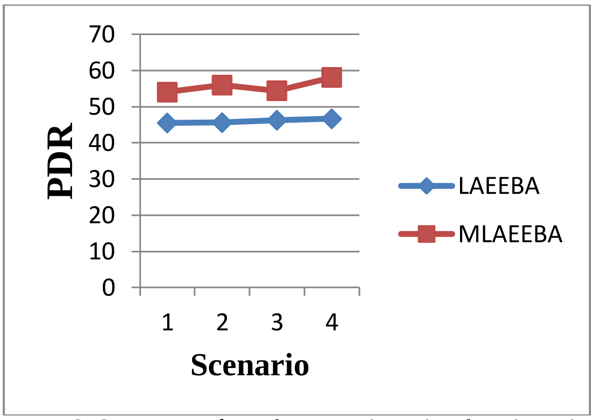

Figure 3: Comparison of PDR between LAEEBA and MLAEEBA

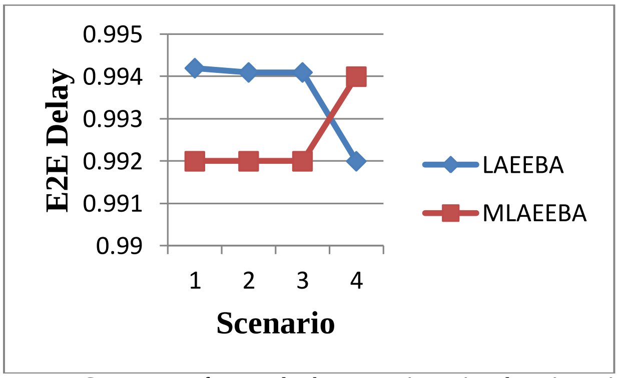

Figure 4: Comparison of E2E Delay between LAEEBA and MLAEEBA

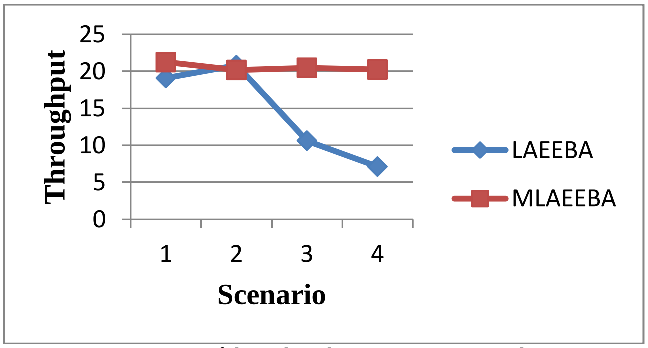

Figure 5: Comparison of throughput between LAEEBA and MLAEEBA

VI. Conclusion

This paper enhances the performance of the LAEEBA protocol. The results show that the proposed technique is better than the existing technique. The comparison is done by using the PDR, E2E Delay and throughput. The delay gets decreased and the throughput gets increased. The PDR in the proposed algorithm is greater than the existing algorithm so the proposed algorithm is better than the existing algorithm. In future, this work can be extended in terms of security. This work is not capable to handle the faulty node; this procedure can be added to extend the work.

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