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AN EFFICIENT SCHEDULING MECHANISM FOR DATA TRANSMISSIONS IN HEALTH CARE NETWORKS

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***Abstract* - In health care networks, Internet of Things connects the patients with doctors and nurses through various devices effectively. The Wireless Body Area Networks play a vital role in the health care networks unlike most existing methods. WBAN communication is the method of transmitting information between WBAN- gateways and the medical centers. In this method, a gateway is assigned for a single patient and various medical packets are aggregated at each gateway. Their medical conditions are immediately reported to the base station with different priority levels based on their emergency. The base station forms the uplink WBAN transmissions by forming a queuing system which specifies the medical-grade Quality of Service requirements depending upon the priority of medical importance. The natural device intelligence of smart gateways in IoT-based networks designs an efficient and truthful mechanism to prevent gateways from misreporting the priority levels of medical packets. By incentivizing the base station, it manages the transmission scheduling in the desired manner by guaranteeing all gateways to honestly report the actual priority levels of the packets. Both theoretical and simulation results show that the proposed mechanism can meet all the requirements in terms of packet transmission.**

Key words - Wireless Body Area Networks, Gateway, Base station, Truthful mechanism for delay constrained networks.

I.INTRODUCTION

In a WBAN, various body sensor nodes are placed on/in the human body to sense various body parameters of the patients. After sensing and collecting the signals, the Local Processing Unit (LPU) collects the sensed data from the sensor nodes [1]. Then, the LPU transmits the data to the local Access points (APs). Finally, it is sent to the medical servers. Since the nodes have limited battery power, the energy consumption rate is restricted. One-hop star topology is used by the sensor nodes to send their medical packets. But the topology is often changed because of different environmental conditions. And also, the link-quality between the nodes also varies with respect to time depending on the movement of body. There are three types of communications in WBAN-based healthcare networks. They are:

- Intra-WBAN communication
- Inter-WBAN communication
- Beyond-WBAN communication

The communication between the body sensors and between body sensor and coordinator are taken into account in intra-WBAN communication. The range of data transmission is about 2 meters. Generally, for WBAN, star topology will work since the size of network is tiny. However, owing to the low transmission power and irregular body movements, great challenges exist or reliable wireless communications. Multi-hop network results in lower transmission power, however higher transmission delays. Because the multi-hop network shortens the transmission distance, the data transmission reliability can be improved. As proposed in the IEEE WBAN standard [2], there can be at most two hops in IEEE WBAN standards compliant communication. The reason is that, with the increase of the hopping number, the communication complexity and overhead will be increased as well. For a network with moderate size, a network design with more than 2 levels may not incur extra benefits. The aim for the communications in inter-WBAN layer is to connect the WBAN with the broader networks that we use every day in our daily lives, such as the cellular network and Internet. This connection is achieved by the communication between the coordinator defined in intra-WBAN, and one or more Access Points (APs). The APs can be integrated as a part of the infrastructure, which is the infrastructure-based architecture, or can be placed dynamically, which is the ad hoc-based arc. Beyond-WBAN communication considers the communication between AP and the outside world, including internet and remote electronic medical care centers. One of the cornerstones of this model is the database that stores user's profile and medical history. The doctor will access to the patient's information when needed. Automatic notifications can be set to send emergency alarms to both doctors and patients when emergency status appears through Internet or short message service (SMS). The doctor can remotely obtain all of the information needed from the wireless sensors worn by patient and the historical data stored in the database.

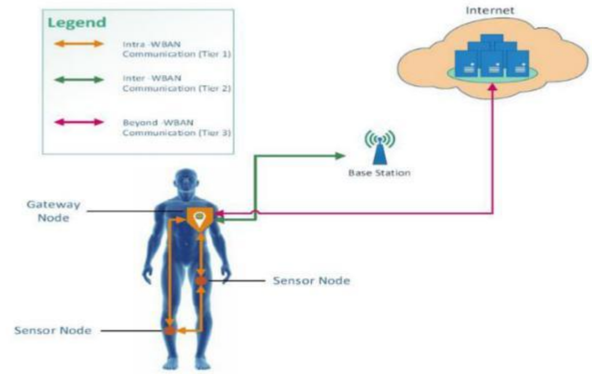

Fig 1.1: WBAN-based healthcare monitoring architecture

Here, considered a WBAN with one coordinator and l sensor nodes on a human body. The coordinator is placed at the front side of abdomen while the sensor nodes are deployed in the different parts of the human body. Both direct transmission and cooperative transmission are allowed in the network. The sensor nodes deployed in the main body part can be selected as relay nodes because of their shorter distance from the coordinator. Relay nodes should not only transmit their own information to the coordinator, but also relay the information from some other nodes when selected as relay. In addition, relay nodes are allowed to use direct transmission only to comply with the IEEE 802.15.6 two-hop tree topology restriction. Only uplink data transmission from sensor nodes to the coordinator is considered due to application scenarios like health monitoring where most of the information transmitted are sensed data. Here assume that the coordinator knows the network topology and the distance between each pair of nodes including it. A simple Time Division Multiple Access (TDMA) Media Access Control (MAC) is employed in this model to deal with multi-sensor transmission [3]. Note that this MAC is a commonly used version of beacon-enabled super frames MAC specified in IEEE 802.15.6. More specific, time is divided into super frames which have fixed length. A super frame has two parts: the active part and the inactive part. The active part consists of fixed-length time slots and each sensor node has one orthogonal time slot to send its sensed data to the coordinator without collision. If a sensor node is selected as a relay, more time slots are given to it. The number of the extra time slots for a certain relay is decided by the number of relayed sensors it has [4]. Each sensor node transmits the sensed data to the receivers (either relay or the coordinator) in its dedicated slot, whereas relay nodes, if necessary, listen to their corresponding sensor nodes for data reception and transmits the relayed data together with their own data to the coordinator in their allocated slots. During the inactive part, nodes go to sleep mode. When a WBAN sets up or re-starts, the time slots allocation will be made by the coordinator depending on the relay selection results. Normal sensor nodes are allocated time slots first before relay nodes. In this project, it is assumed that all nodes have enough sensed data to send during their allocated slots.

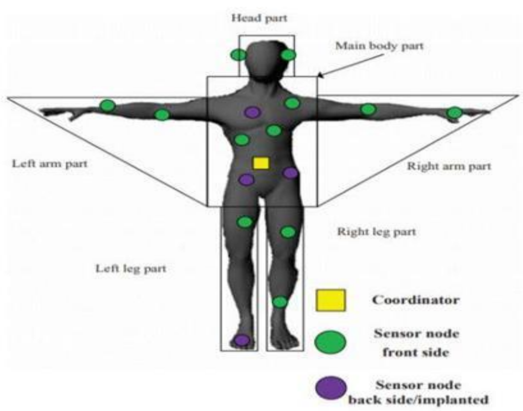

Fig 1.1. Network model.

II.METHODOLOGY

A. Network Model

In IoT-based healthcare monitoring, the remote collection of patients' physiological information relies on multi-tier network architecture, called WBAN, as illustrated in Fig. 1. In this paper, with the specific focus on medical packet transmissions from patients to the medical center, we consider a cellular-like

beyond-WBAN communication model consisting of a single BS and K gateways (each of which represents one patient) [5]. The BS is responsible to manage the scheduling of medical packet transmissions from all gateways on N homogeneous and orthogonal channels that are dedicated for healthcare services. Each gateway aggregates a variety of medical packets (e.g., EEG, ECG and EMG) generated by its associated biosensors through intra-WBAN communications (which has been standardized in IEEE std. 802.15.6), and then forward them to the BS through beyond-WBAN transmissions. According to the existing standard, medical packets are categorized into a finite set of priority levels, denoted by L = {0, 1. . . L}, where 0 and L represent the lowest and the highest priority levels, respectively. In IoT-based healthcare networks, each WBAN consists of up to 256 heterogeneous biosensors deployed on a patient, and it is expected that with the developments in lightweight sensors and the low-power transmission technologies, this number may even increase for fulfilling more comprehensive and accurate healthcare monitoring [6]. Thus, at each gateway k, ∀k ∈ {1, 2, . . . , K}, the aggregate arrival of medical packets collected from a large number of

independent biosensors can be well approximated as a Poisson process with an average rate λk. However, our proposed mechanism can also be applied to scenarios where packet arrivals are more generally distributed. Besides, with a long-term health condition tracking on patients, it is reasonable to assume that there is a known distribution Pk = (Pk,0, Pk,1, . . . , Pk,L) on the medical packet arrival from different priority levels at each gateway k, ∀k ∈ {1, 2, . . . , K}, where Pk, indicates the probability that an arrived medical packet at gateway k is in priority level , ∀ ∈ L.

Obviously, PL =0 Pk = 1. Thus, the average arrival rate of medical packets in priority level at gateway k can be calculated as λk, Pk, ∀k ∈ {1, 2, . . . , K}, ∀ ∈ L. To join the beyond-WBAN for transmitting any medical packet to the BS, each gateway is required to immediately declare a transmission request along with the corresponding packet priority when it receives a packet from the intra WBAN.

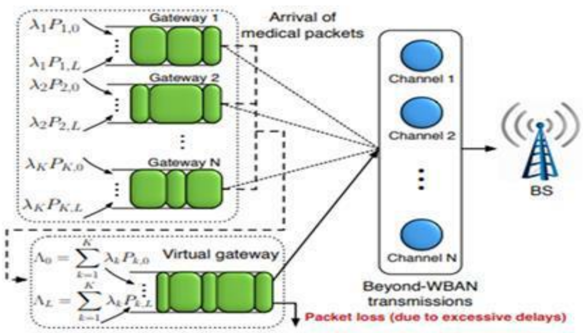

Fig 2.1. Queuing model of the transmission scheduling.

All medical packets that have not been scheduled for beyond-WBAN transmissions are temporarily stored in gateways' buffers. In this paper, we do not consider buffer over flow. However, it is worth noting that since medical packet transmissions are delay-constrained (i.e., there is a stringent delay requirement for each medical packet), a medical packet will be dropped by the gateway (and will no longer be transmitted) whenever it has been waiting longer than its required delay limit. Since delay limits of various medical packets may be different, we can define a generic random variable D to describe the packets' delay limits observed by the BS (while the realizations of packets' delay limits are allowed to be different). Note that these delay limits may lead to potential packet loss in the beyond-WBAN scheduling system [7]. As the network controller, the BS schedules the uplink transmissions of medical packets from all gateways in the beyond WBAN. To guarantee medical-grade QoS, i.e., medical packets with higher criticality (in higher priority levels) should always be delivered/reported before the others with less emergency (in lower priority levels) the BS will determine the beyond WBAN transmission order purely based on medical packets' priorities, and independent of the identities of gateways [8]. Thus, the BS can treat all transmission requests from a single virtual gateway, as depicted which consists of L+1 different arrival process with respect to the total L + 1 priority levels in L. Because of the independency among gateways, their aggregate arrivals at the virtual gateway are still Poisson distributed, and the average rates are

$$\Lambda_\ell = \sum_{k=1}^{K} \lambda_k P_{k,\ell}, \quad \forall \ell \in \mathcal{L}.$$

Considering the diversities in term of packet sizes and achievable signal-to-noise ratios (SNRs) at different gateways, medical packets may experience different beyond-WBAN transmission time. From the view of the network controller (i.e., the BS), the transmission time of medical packets on a beyond-WBAN channel can thus be represented by a generic random variable T. Then, we can formulate the operation of the beyond-WBAN transmission scheduling as a multi-class delay-constrained multi-server priority queuing system with L+1 Poisson-distributed packet arrivals corresponding to L+1 priority levels, different service time (i.e., transmission time), heterogeneous delay limits, and N servers (i.e., channels). Queuing model of medical packet transmissions are beyond-WBAN. Note that, the overhead caused by control signaling is ignored since it is negligible compared to regular medical packet transmissions.

B. Problem Formulation

Naturally, patients will benefit from pervasive healthcare monitoring. Such benefit implies a utility gain at each gateway for successfully transmitting a medical packet to the BS in the beyond-WBAN. To characterize this, v is defined as the valuation for the successful beyond-WBAN transmission of a medical packet in priority level ∀ ∈ L. Intuitively, packets with higher priorities have higher valuations. Thus, we must have

$$v_0 < v_1 < v_2 < \ldots < v_L.$$

Denote V = {v0, v1, . . . , vL}. In practice, V can be predetermined by medical specialists, and hence can be considered as a common knowledge to all gateways and the BS in the network. For explanation purpose in later analyses, we let v+1 − v = δ, ∀` ∈ {0, 1, . . . , L − 1}, where δ > 0 is a pre-defined system parameter. On the contrary, for each medical packet i, its priority level `i ∈ L is a private information that is only available to the associated gateway, while unknown to other gateways and the BS. According to the network model, upon receiving medical packet i with priority `i , the associated gateway will immediately declare a beyond-WBAN transmission request to the BS by reporting the priority level of this packet. However, as an intelligent and rational entity, a smart gateway may strategically report ` 0 i 6= `i if and only if it can benefit more from such behavior. By taking into account all gains and costs of a medical packet transmission in the beyond-WBAN, the net utility obtained by the gateway from transmitting packet i with actual priority `i but reporting ` 0 i can be defined as

$$U_i(\ell'_i|\ell_i) = v_{\ell_i} \cdot (1 - x(\ell'_i)) - \pi(\ell'_i),$$

where x(` 0 i ) ∈ {0, 1} is the indicator of packet loss (i.e., x(` 0 i) = 1 means that packet i is dropped due to the over-limit waiting delay, and x(` 0 i ) = 0 otherwise); v`i and π(` 0 i) are the valuation of successful packet transmission and the charge by the BS for beyond-WBAN channel service, respectively. Since the BS is unaware of gateways' private information about the actual priorities of their data packets, it is intuitive that the beyond-WBAN transmission scheduling outcomes (i.e., x(` 0 i ) and π(` 0 i)) are based on the reported priority level ` 0 i . Obviously, as an essential requirement to guarantee medical grade QoS (i.e., the proper execution of the absolutely prioritized transmission scheduling), the designed mechanism should be able to induce all gateways to truthfully report the actual priority levels of their medical packets. Note that is an ex-post utility function because the packet loss indicator x(` 0 i) depends on the instantaneous queuing performance of the system, which is unknown in advance. Thus, a smart gateway will consider to potentially misreporting the priority of a packet only for maximizing its expected utility. To prevent such misreport, we introduce the following truthfulness condition:

$$\ell_i = \arg\max_{0 \le \ell'_i \le L} \{\mathbb{E}[U_i(\ell'_i|\ell_i)]\}, \quad \text{for any packet } i.$$

The above equation indicates that the expected utility of transmitting packet i, i.e., E[Ui(` 0 i |`i)], is always maximized when the gateway behaves truthfully by reporting ` 0 i = `i . With the utility function (3), E[Ui(` 0 i |`i)] can be expressed as

$$\mathbb{E}[U_i(\ell'_i|\ell_i)] = v_{\ell_i} \cdot (1 - Q(\ell'_i)) - \pi(\ell'_i),$$

where Q(` 0 i ) indicates the packet loss probability given priority level ` 0 i . Substituting (5) into (4), we can rewrite the truthfulness condition in a general form as

$$v_\ell(1 - Q(\ell)) - \pi(\ell) \ge v_\ell(1 - Q(\ell')) - \pi(\ell'), \ \forall \ell, \ell' \in \mathcal{L}.$$

In addition, to encourage medical packet transmissions in the beyond-WBAN, the designed mechanism should also ensure individual rationality, i.e., non-negative expected utility for transmitting any packet that is reported truthfully:

$$\mathbb{E}[U(\ell|\ell)] = v_\ell(1 - Q(\ell)) - \pi(\ell) \geq 0, \ \forall \ell \in \mathcal{L}.$$

Meanwhile, the BS aims to maximize its revenue gained from beyond-WBAN transmissions of all medical packets. If packets' priority levels are reported truthfully, the expected revenue of the BS can be calculated as

$$\mathcal{R} = \sum_{\ell=0}^{L} \Lambda_\ell \cdot \pi(\ell),$$

where Λ`π(`) is the average service charge on beyond-WBAN transmissions of medical packets in priority level `, ∀` ∈ L. It is worth noting that the packet loss probability, Q(`), ∀` ∈ L, is not necessary to be included in (8). This is because π(`), ∀` ∈ L, is actually a function of Q(`), ∀` ∈ L (which will be discussed in Section IV-B), so that the definition of R already implies the expected revenue charged from successful beyond-WBAN transmissions [9]. As the network controller, the BS determines the scheduling discipline ζ and the pricing rule π = [π(0), . . . , π(L)] for maximizing R subject to required system constraints.

C. Existing System

In existing system, a radio resource allocation scheme for wireless body area networks (WBANs) is proposed. Unlike existing works in the literature, we focus on the communications in beyond-WBANs, and study the transmission scheduling under a scenario that there are a large number of gateways associating with one base station of medical centers. Motivated by the distinctions and requirements of beyond-WBAN communications, we introduce a priority-aware pricing-based capacity sharing scheme by taking into account the quality of service (QoS) requirements for different gateways [11]. In the designed scheme, each gateway is intelligent to select transmission priorities and data rates according to its signal importance, and is charged by a price with regard to its transmission request. The capacity allocation is preceded with guarantee of the absolute priority rule. In order to maximize the individual utility, gateways will compete with each other by choosing the optimal transmission strategies. Such decision process is formulated as a non-atomic game [10]. Theoretical analyses show that our proposed pricing-based scheme can lead to an efficient War drop equilibrium. Through numerical results, we examine the convergence of strategy decisions, and demonstrate the effectiveness of our proposed mechanism in improving the utilities of gateways.

D. Disadvantages of Existing System

- Suffer high chances of packet loss
- More complex
- Deep fading affects the reliability of transmissions
- Lower efficiency

E. Proposed System

In IoT-based healthcare monitoring, the remote collection of patients' physiological information relies on multi-tier network architecture, called WBAN. In this project, with the specific focus on medical packet transmissions from patients to the medical center [12], we consider a cellular-like beyond-WBAN communication model consisting of a single BS and K gateways (each of which represents one patient). The BS is responsible to manage the scheduling of medical packet transmissions from all gateways on N homogeneous and orthogonal channels that are dedicated for healthcare services. Each gateway aggregates a variety of medical packets (e.g., EEG, ECG and EMG) generated by its associated biosensors through intra-WBAN communications (which has been standardized in IEEE std. 802.15.6, and then forward them to the BS through beyond-WBAN transmissions [13]. According to the existing standard, medical packets are categorized into a finite set of priority levels, denoted by L = {0, 1, . . . , L}, where 0 and L represent the lowest and the highest priority levels, respectively. In IoT-based healthcare networks, each WBAN consists of up to 256 heterogeneous biosensors deployed on a patient , and it is expected that with the developments in lightweight sensors and the low-power transmission technologies, this number may even increase for fulfilling more comprehensive and accurate healthcare monitoring [14] .Thus, at each gateway k, ∀k ∈ {1, 2, . . . , K}, the aggregate arrival of medical packets collected from a large number of independent biosensors can be well approximated as a Poisson process with an average rate λk. However, our proposed mechanism can also be applied to scenarios where packet arrivals are more generally distributed [15]. Besides, with a long-term health condition tracking on patients, it is reasonable to assume that there is a known distribution Pk = (Pk,0, Pk,1, . . . , Pk,L) on the medical packet arrival from different priority levels at each gateway k, ∀k ∈ {1, 2, . . . , K}, where Pk,` indicates the probability.

F. Objectives of the Project

- The management of beyond-WBAN transmissions for IoT-based healthcare networks is modelled as a multi-class delay-constrained multi-server priority queuing system [16].
- Based on derived queuing outcome and observed characteristics, a truthful mechanism for scheduling medical packet transmissions with delay constraints is proposed.
- Theoretical and simulation results show that our proposed mechanism can meet all design requirements, and can achieve a superior performance compared to counterparts.

G. Advantages of Proposed System

- Reduce the power consumption of medical nodes
- Reduce network contention
- Minimizes energy consumption
- Reduce packet loss ratio

III.ARCHITECTURE

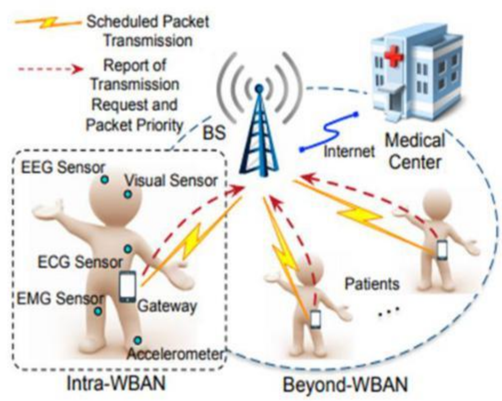

Fig 3.2 IoT-based healthcare monitoring.

A. Block Description

a. WBAN

In IoT-based healthcare monitoring, the medical packet transmissions from patients to the medical centre, consider a cellular-like

beyond-WBAN communication model consisting of a single BS and K gateways (each of which represents one patient). The BS is responsible to manage the scheduling of medical packet transmissions from all gateways on N homogeneous and orthogonal channels that are dedicated for healthcare services [17]. Each gateway aggregates a variety of medical packets (eg. EEG, ECG and EMG) generated by its associated biosensors through intra-WBAN communication and then forwards them to the BS through beyond-WBAN transmissions [18]. According to the existing standard, medical packets are categorized into a finite set of priority levels, denoted by L = {0, 1, . . . , L}, where 0 and L represent the lowest and the highest priority levels, respectively. In IoT-based healthcare networks, each WBAN consists of up to 256 heterogeneous biosensors deployed on a patient, and it is expected that with the developments in lightweight sensors and the low-power transmission technologies, this number may even increase for fulfilling more comprehensive and accurate healthcare monitoring. Thus, at each gateway k, ∀k ∈ {1, 2, . . . , K}, the aggregate arrival of medical packets collected from a large number of independent biosensors can be well approximated as a Poisson process with an average rate λk. However, our proposed mechanism can also be applied to scenarios where packet arrivals are more generally distributed.

b. Gateway

Multi-class medical packets generated by biosensors arrive randomly at each gateway via intra-WBAN communications stored in gateways' buffers until they have been successfully transmitted to the BS or dropped by gateways due to excessive delays [19] (i.e., waiting longer than their required delay limits).

c. Base Station

Upon receiving a medical packet, the associated gateway will immediately declare a beyond-WBAN transmission request to the base station (BS) which is further connected to remote medical centers via Internet [20]. The packet-level operation of the beyond-WBAN transmission scheduling is then formulated as a multi-class delay-constrained multi-server priority queuing system. Based on this model, an efficient mechanism is proposed which can ensure that all smart WBAN-gateways will truthfully report their packet priority levels and can incentivize the BS to manage the transmission scheduling system by maximizing its revenue.

d. Medical Centre

The sensed physiological signals are first collected at a gateway for data aggregation via intra-WBAN communications (i.e., from biosensors to the gateway) and then forwarded to remote medical centers for interpretation and analysis via beyond-WBAN communications (i.e., from gateways to remote medical centers) [21]. Gateways in IoT-based WBANs can be patient's smart phones or any other smart devices, each of which ordinarily stands for one patient.

IV.RESULTS AND DISCUSSION

4.1 Results

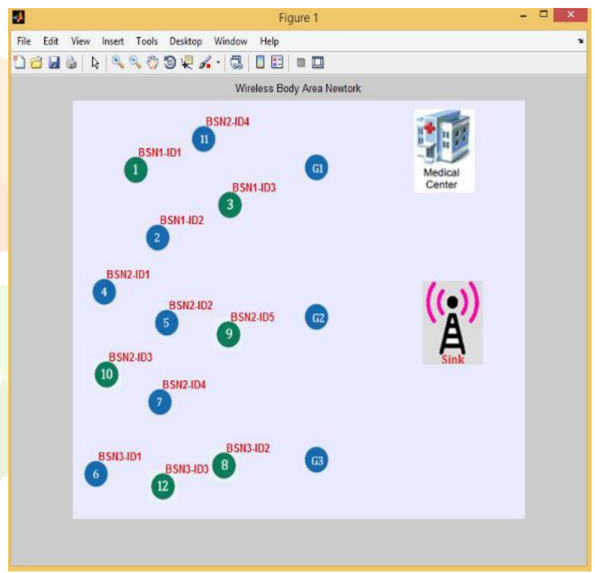

Fig.4.1.1: Network model of WBAN

The figure 4.1.1 shows the network model of Wireless Body Area Network in which the sensors are deployed in a random manner. The nodes are arranged to pass the data to the sink which is our destination.

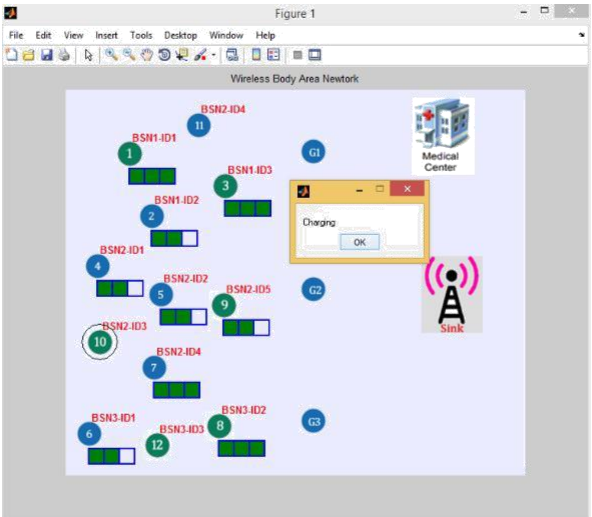

Fig. 4.1.2: Charging Bio-Sensor of WBAN

The figure 4.1.2 shows that the sensors are automatically charged for further transmission at regular intervals for neglecting failures. The charging levels are checked often to improve the efficiency.

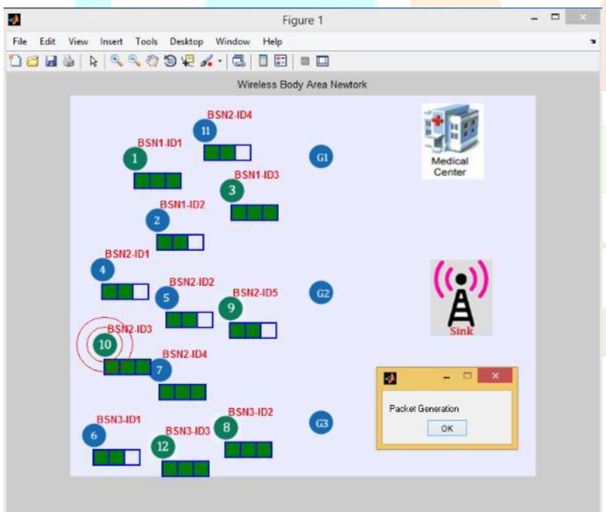

Fig. 4.1.3: Packet Generation

The figure 4.1.3 shows that the data packets needed for transmission are generated from the source based on the emergency. Then they are transmitted to the sink.

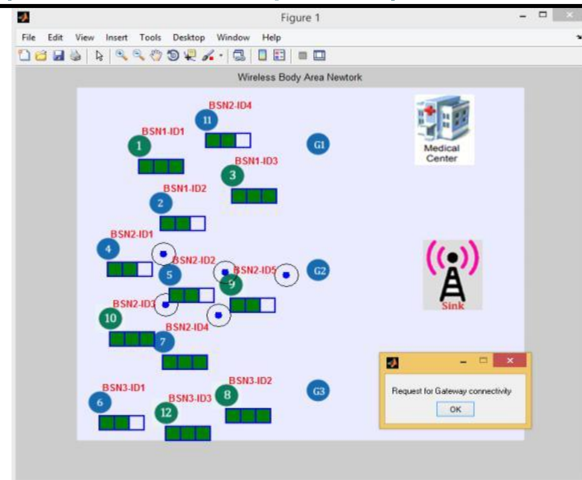

Fig.4.1.4: Request to Gateway Connectivity

The figure 4.1.4 shows that the request is sent to the gateway for seeking permission for transmission. Since the priority level varies for every single data packet, the permission will be based on the priority.

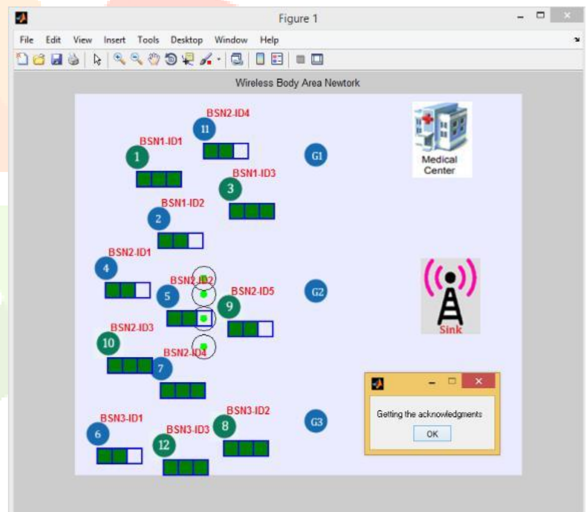

Fig.4.1.5: Getting the acknowledgements

The figure 4.1.5 shows that the sender receives the acknowledgement for the requests sent by different nodes. After getting the response, the transmission takes place.

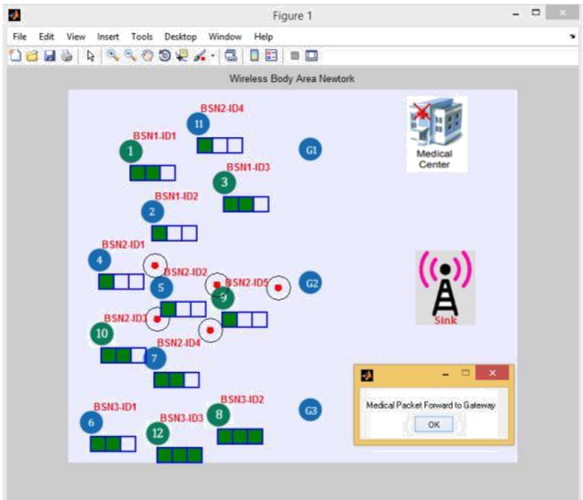

Fig. 4.1.6: Medical packet forwarded to Gateway

The figure 4.1.6 shows that after the response from the server, the medical packets are forwarded to gateway based on the quality of services and priority.

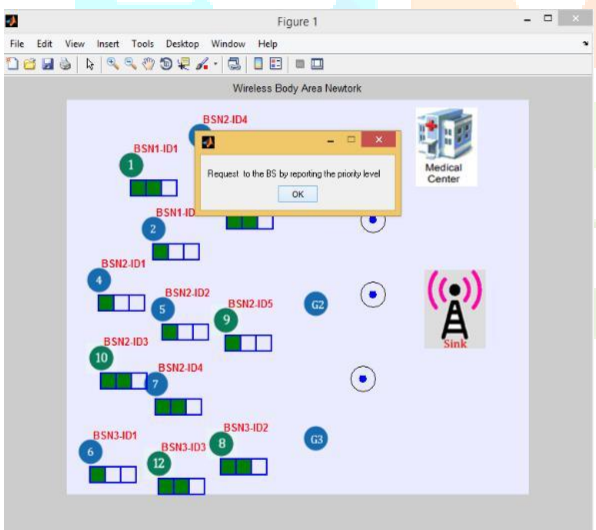

Fig. 4.1.7: Request to the base station

The figure 4.1.7 shows that after collecting the data packets, the request is being sent to the base station based on the emergency. Emergency of packets are known based on the priority levels.

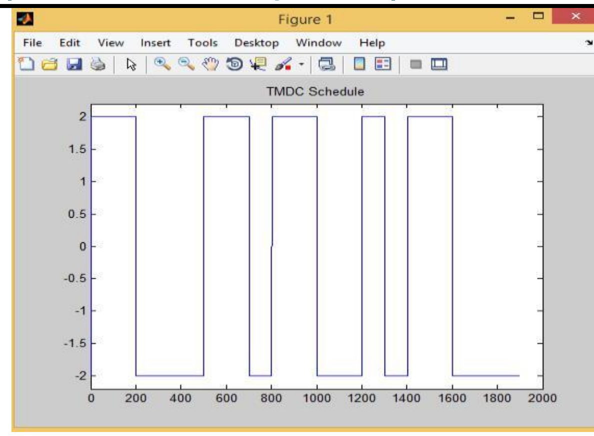

Fig. 4.1.8: TMDC schedule

The figure 4.1.8 shows that the priority levels for each data packets are scheduled for the active transmission of data to the sink. The packets with high priority are needed to be send first.

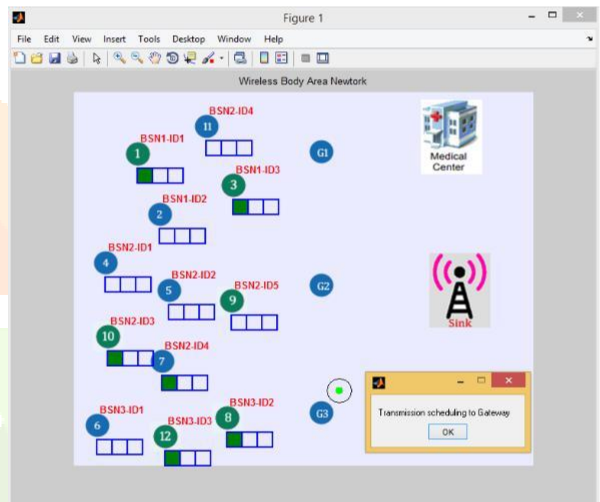

Fig. 4.1.9: Transmission scheduling to gateway

The figure 4.1.9 shows that the priority levels which are set for various data packets are sent to gateway for further transmission of data. Wireless transmissions are highly activated at gateways for accurate transmission to avoid packet loss.

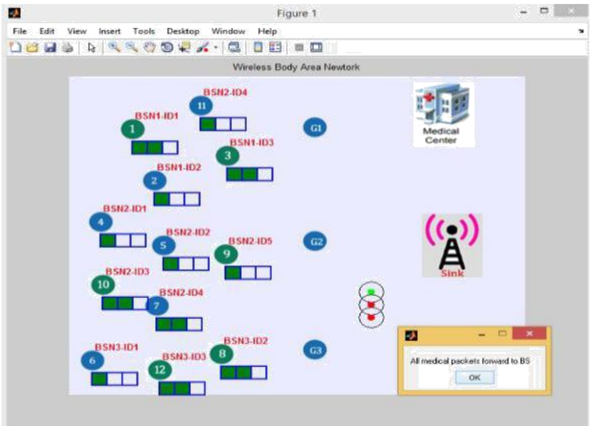

Fig. 4.1.10: Packets forwarded to BS

The figure 4.1.10 shows that the packets are forwarded to base stations from the gateway to reach the sink. The data losses can be avoided at each stage for the accurate transmission of packets.

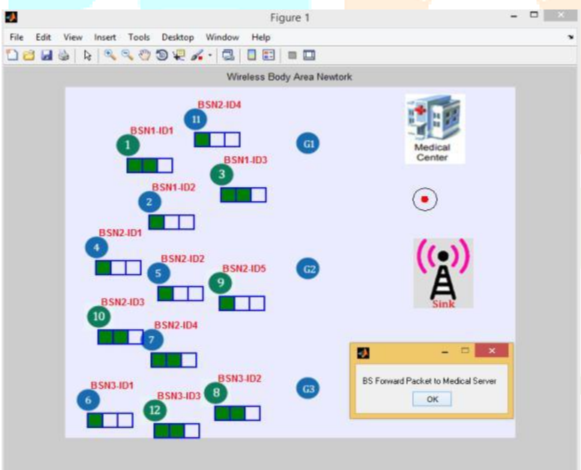

Fig.4.1.11: BS forwarded packets to server

The figure 4.1.11 shows that finally, the data packets are sent to the medical server which is the final destination.

4.2 Discussion

Simulations are conducted to evaluate the performance of our proposed mechanism TMDC in managing delay-constrained transmissions in IoT-based healthcare networks

Fig. 4.2.1 depicts the beyond-WBAN transmission probabilities of medical packets with different priorities in the delay constrained network scenario. Here, the transmission probability is defined as the probability that a medical packet is transmitted in the beyond-WBAN within its required delay limit. From this figure, it is observed that when the proposed TMDC or DTM-L mechanism is employed, medical packets in a higher priority level have a higher transmission probability [22]. This is because both TMDC and DTM-L mechanisms are priority-aware, namely a better beyond-WBAN transmission service is always granted for medical packets with a higher priority. However, due to the extra delay control which introduces additional delays for medical packets in lower priority levels, the overall performance of DTM-L is worse than that of our proposed TMDC. Furthermore, the non-priority mechanism treats all transmission requests equally, so that the transmission probability remains unchanged for medical packets in any priority level [23]. As a consequence, the QoS of emergent medical information deliveries is completely unprotected, which may cause serious issues in healthcare.

Fig. 4.2.2 further evaluates the queuing performance of the designed TMDC in the considered beyond-WBAN transmission scheduling system by investigating the mean waiting delays experienced by successful transmissions of medical packets in different priority levels [24]. Here, the packet delay is defined as the time duration between the instant when the medical packet arrives and the instant when it is scheduled for beyond-WBAN transmission. From this figure, can clearly see that the mean delay of medical packets in beyond WBAN transmissions decreases with the increase of the packet priority level.

Fig. 4.2.3 examines the truthfulness of TMDC by analyzing the transmission utility of a medical packet with different reported packet priority levels. In the considered IoT-based beyond WBAN implementing TMDC, intelligent gateways can strategically report the packet priority level so as to maximize the transmission utility of each medical packet. The trend of the curves in Fig. 4.2.3 shows that the transmission utility of a medical packet first increases with the reported priority level 0.

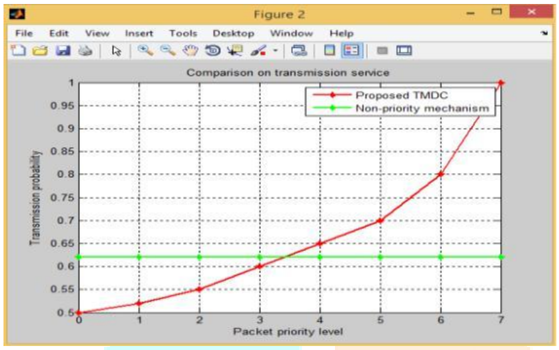

Fig: 4.2.1 Comparison of transmission service

The difference between the existing and proposed system are shown in figure 4.2.1. There are advantages for proposed system when compared to existing system.

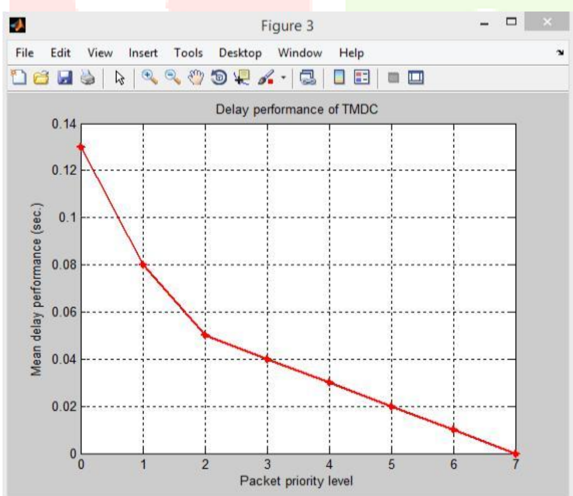

Fig: 4.2.2 Delay performance of TMDC

The delay performance of TMDC is shown in figure 4.2.2 .Various data packets are sent at different priority levels. Therefore, delay is an important factor for estimating the performance.

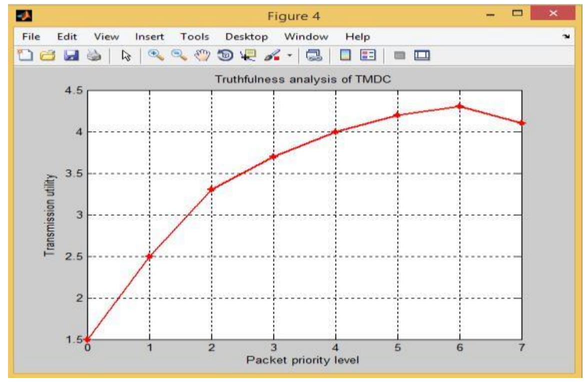

Fig: 4.2.3 Truthfulness analysis of TMDC

For various time and emergency ratings, the priority level is shown based on the Quality of Service in the figure 4.2.3. The truthfulness analysis is made for better transmission and accuracy.

CHAPTER 5

CONCLUSION AND FUTURE WORK

5.1 CONCLUSION

In this project, the management of delay-constrained medical packet transmissions in IoT-based healthcare networks has been studied [25]. To characterize the dynamic nature of wireless transmission scheduling integrating the medical-grade QoS requirements, a priority-aware queuing system is formulated and analyzed. Considering the intelligence of gateways in the IoT-based beyond-WBAN, we propose a truthful and efficient mechanism, i.e., TMDC, which can guarantee all gateways to honestly report the actual priority levels of their medical packets, while incentivizing the BS to participate in the beyond-WBAN scheduling. Simulation results show that the proposed mechanism can meet all design requirements and outperform the counterparts in terms of packet transmission probability and network revenue.

5.2 FUTURE WORK

In future work, propose a joint energy-efficient and distributed network management cost minimization framework for dynamic connectivity and data dissemination in opportunistic WBANs. The proposed network minimization framework consists of two steps. In the first step, design an opportunistic data dissemination algorithm to minimize the service delay of the network. Finally, design an optimal network minimization framework to decrease the increased network management cost caused by the mobility of WBANs.

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