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An Enhanced Approach for Providing EES in Bluetooth Network

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Abstract:
Bluetooth network provides a propitious technology which is wireless and allows short assortment connection to form ad hoc network. With its squat power ability, proposed technology works in the assortment of 2.4 to 2.5 GHz. These equipment not only share a wireless channel to form a piconet but also form a scatternet by interconnecting two or more piconet having a maximum number of 8 nodes with1 master and 7 slaves. Complexity is to attain a high EES (Enhanced Eminence service) with less latency. Here, EES refers to QOS (Quality of services) the productive and efficient management of system assets, which includes the parameters like delay, bandwidth, and jitter.This paper, addresses the concern of boosting the EES support in a piconet. We propose here scheduling algorithm (MAC) which afford different EES for dissimilar link, based on priorities. In view of the feature master driven duplex communication links, we define token counters to approximate traffic of real-time slaves. To enhance bandwidth utilization, a back-off method is then presented for best-effort slaves to decrease the occurrence of polling, inactive slaves. Simulation results exhibit that our system achieves better performance over the on hand schemes.

***Key words**: Piconet, Bluetooth, EES, Scatternet, MAC scheduling, TDD, Round Robin (RR)*

1. Introduction

Wireless communication is a feasible, robust multimedia communication mechanism. Having multiple requests, several devices, may be linked using a Bluetooth Network. It may result with a network overhead of its own. For any data transmission reliability, accuracy, completeness, consistency, and robustness must be achieved. With several scheduling schemes previously proposed, had several scheduling and resource allocation problems. Some of the major pitfalls encountered in these schemes that affect the EES in Bluetooth scatternet are Packet loss, delay, Traffic congestion, etc...

Existing scheduling schemes are just involved in providing best-effort service for M-S (master slave) connection. They fail in providing enhanced efficient service to the devices that are involved in connection. Having its own scheduling algorithms, we try to achieve to achieve high channel utilization (throughput)., It is very challenging to provide EES for different connections When a master is involved with TDD. In This paper, we try to address the issues of how to implement EES in a Bluetooth piconet.

Scheduling becomes a complex task in multimedia and other audio-visual applications, here packet size is not of fixed length and EES is considered only for the parameters associated with voice. With a better EES and scheduling scheme, designed system becomes much efficient. Considered process uses a TDD scheme to divide the channel into 625 µs time slots. Switching the time slots alternatively between the master and slaves. Master then uses an even numbered slot while, the slave uses an odd numbered slot. It's the master that controls the transmission process.

2. Literature Survey

[1] Kalia et al. For the purpose of knowing several scheduling algorithms, I did a survey of this book regarding these policies that utilized information about HOL packet.

[2] Das et al. proposed other schemes based on queue lengths on which scheduling schemes and its algorithms were structured Some of these algorithms solved the bandwidth wastage to some extent, they were lacking information about the queues at slaves which is not available in the current Bluetooth specification.

[3]Bruno, M. Conti and E. Gregori. Efficient Double-Cycle (EDC) used a truncated binary exponential back-off mechanism to enthusiastically adapt the polling frequency in accordance with traffic conditions,one advantage was it ensures that there is no bandwidth wastage. This algorithm didn't need any extra information but it still didn't solve the issue of EES completely.
[4] Chawla et al. proposed a QoS, to what i am referring to as EES based scheme, called *ACL*, to schedule voice with EDD policy over ACL qos for voice was met to certain extent.
Although this scheme did address the issue of EES, it only distinguished voice from data and couldn't be extended to the case of multi-class traffic. Moreover, with the EDD policy, the master still needed to know the arrival time of packets at slaves.

3. Statement of Problem

Considering practical applications, we got to know that multimedia applications are in need of better EES parameters in order to guarantee the delivery of message. Available IEEE Bluetooth specifications are not concerned with EES requirements, existing Bluetooth Services provide Best-Effort Service to all the applications, with an increased delay and less bandwidth.

3.1. Objective of Work

In order to support systems associated with piconet, we proposed a priority scheduling scheme associated with Media access layer. To perform this, we differentiate slaves into two or more slots and schedule them In accordance with requirements. On scheduling them efficiently, for a better RR algorithm, we identify some token counters to estimate the traffic by some back-off mechanism for best-effort slaves decay the polling occurrence regularly.

3.2. Scope and Importance of the Work

Piconet systems based on IEEE standards associated with Bluetooth are designed to have scheduling schemes that prioritizes slaves based on the information they send when they have nothing to send. Proposed algorithm performs better than round robin and other traditional schemes.
RR Is associated with best effort services but it does not concentrate on EES, as a result, it leads to an increased delay and low bandwidth. To alleviate this problem, we proposed some scheduling algorithms. To some extent we could overcome the problem of bandwidth wastage, but there was a need to know extra information about the queues and slaves which is not available in the IEEE Bluetooth specification. Hence the proposed algorithm enhances the EES, without wasting slots. Decreasing the time delay and thus increasing the efficiency.

4. Scheduling Scheme

Figure 1 shows the scheme that is in use in our project. Here, a Piconet system associated with IEEE based Bluetooth standards are considered, and information for the same is transmitted using a channel. This channel access is monitored by the master and its slave is associated with sending a packet only after its reception from master. Present IEEE Bluetooth Standards adapt a round-robin scheme with respect to ACL connections these, utilize low bandwidth and an increased delay when one or more than one slaves have a null to transmit.

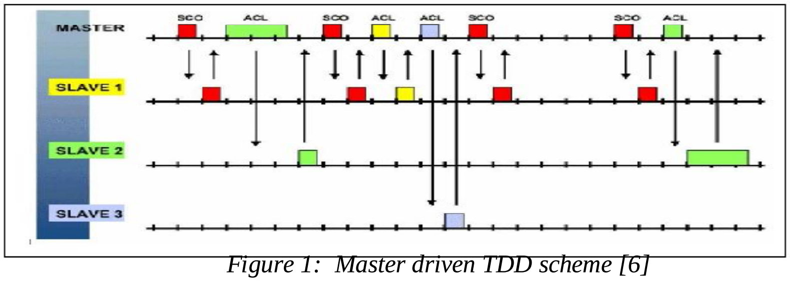

Figure 1: Master driven TDD scheme [6]

With respect to a master slave, Bluetooth system wires two different types of communication channels

- Synchronous Connection Oriented (SCO) link
- Asynchronous Connection Less orientation (ACL) link.

Is not SCO provides a circuit-oriented services with steady bandwidth and periodic slot alignment. This is applicable in delay-sensitive multimedia applications. Where as an ACL supports a packet-oriented services. The ACL connection is suitable for various applications such as File Transfer, Telnetwork, audio visual applications. These various multimedia applications have their own efficiency parameters. Current Bluetooth specification associated with its EES RR and other schemes are associated with their own scheduling and allocation problems. Hence a new scheme that concentrates on efficiency parameters is considered.
For the purpose of solving the above mentioned problems, in this paper, we tried to develop a priority based algorithm that improves EES in the Piconet devices. Our main objective is to assign priority to the slave by dividing it in real time to improve its performance parameters, to estimate the traffic of the slaves in real time we considered its token counters. Using this, we apply some back-off mechanism (exponential) and decrease its polling frequency.

4.1. Priority-Based Mac Scheduling Scheme

In the RR system each client (slave) can transmit one packet still when there is no packet to transfer with similar opportunity for clients to transmit packet. The time period is allotted to the slave when the master polls a client (slave), without checking whether the slave has data to transmit or not. Numerous algorithms (MAC) have already been projected to progress the system recital.

Present Bluetooth can offer voice support over SCO links. In this part, we intend a priority based scheduling scheme to transmit multimedia data (including voice) over ACL connections with EES provision.

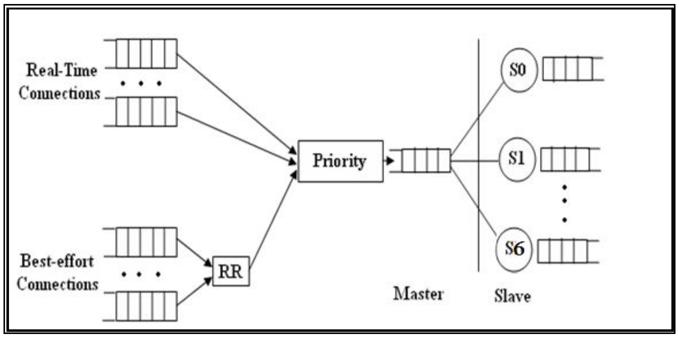

Figure 2: A priority-based MAC scheduling scheme [7]

Due to the facet of Master Driven TDD, a slave can send a packet only after it has received a polling packet from the master. This result in:

- The master cannot know whether a slave has data to transmit unless it (master-slave) links into two classes: one is real time links whose packets should be sending as soon as possible to meet their delay requirements; the other one is best-effort links that have no EES requirement. The links that have no data to send in same way belong to the next class. Every real-time link is given a unique priority based on its delay necessity. If two links have the same delay, the previous one will get a higher priority. All the best-effort links are given the same priority, the lowest one. We arrange real-time send a polling packet to the slave.
- When there is no data to send by any one of the slave, polling them will decrease bandwidth consumption. Our solutions are described below:

Slaves strictly based on their priorities and best-effort slaves in round-robin system.

The arrangement of our scheme with one master and seven slaves shows in Figure 2. The master looks for packet in a queue for each slave which maintains its own queue. For providing diverse EES for different slaves, we categorize the MS

In our proposed algorithm, we assign a priority which is unique Pj to slave Sj according to MDj. The slaves with least value of MDj are given the highest priority. This ensures sensible delay performance for the slaves. The actual time data from the client (slaves) are schedule according to the priority. Token counter Cj is used to shun regular polling of the client (slaves).

The value of Cj is increased by 1 per Tj seconds, where Tj = Lj / Rj

Sj	Slave J
Rj	Average bit rate of Sj
MDj	Maximum accepted delay of Sj
Lj	Packet Length of Sj
Cj	Token Counter of Sj
Tj	Token counter generation Interval of Sj
Pj	Priority of Sj
PIj	Polling Interval of Sj
Wj	Polling Window of Sj
WMX	Maximum window size

Table 1: Notations Used In This Paper

We used the EB (exponential back-off) algorithm which performs the following functions.

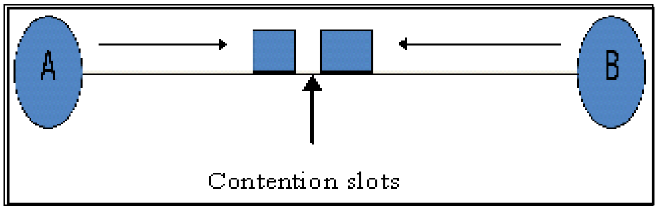

Figure 3: Exponential Back-Off Algorithm

- Method of randomization of packets when collision occurs.
- Back-offs and Retransmits.
- MAC unit delays for a random integral number of slot times.
- Slot time is in binary.
- Delay slot time increases exponentially.

The EB algorithm is used to evaluate the amount of time inactive slave is removed from the polling cycle. For each best effort slave Sg, the value of Wg is set to 1 by default and updated with a binary exponential back-off mechanism. The value of Ig is set according to Wg.

Our scheduling algorithm proceeds as follows:

- Program the real-time slave (client) with the highest priority, S. If the master has any packet for Sj, propel them to S. If Sj returned a NULL packet after the master sent out all the packets, set Cj to 0; otherwise, keep polling Sj until it returns a NULL packet and then set Cj to 0.
- Program slaves with lower priorities with the same policy used in 1.
- A slave with a lower priority is scheduled only when all slaves with higher priorities have no packet to transmit.
- When token counter is 0 and the master has no packet to send slaves is considered to have no packet to send out.
- Once all real-time client (slaves) have no packet to transmit, the best-effort slaves are scheduled in round robin way.
- 6.When scheduling best-effort slaves, if the master sends a NULL packet to K S and a NULL packet is returned, Wg is doubled unless a maximum value max W is reached; otherwise Wg is set to 1.Then Ig take the value of Wg.
- For each cycle first the best-effort client (slaves) are scheduled, and then polling period of every slave is decreased by 1 until a value 0 is reached. Slaves with polling period 0 can send out packets.

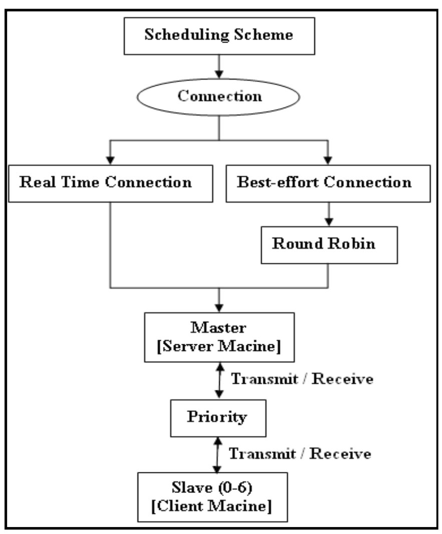

Figure 4: Scheduling scheme Flow chart

5. Simulation Results

The simulation in this segment is to show the performance of our layered scheme (MAC). In our simulation, we apply 2 algorithms using JAVA language: 1) our scheme that is the (MAC) scheme, and 2) RR (Round Robin) scheme.

The simulation pattern composed of a server (master) and seven clients (slaves) shown in Figure 3 is a piconet. For simulation we consider two slaves client0 and client1 each one is assigned with the same bit rate. Then assign the server name which controls the communication between the clients. In the master form we assign the maximum delay. By assigning different delay we can compute our program and compare with the previous result.

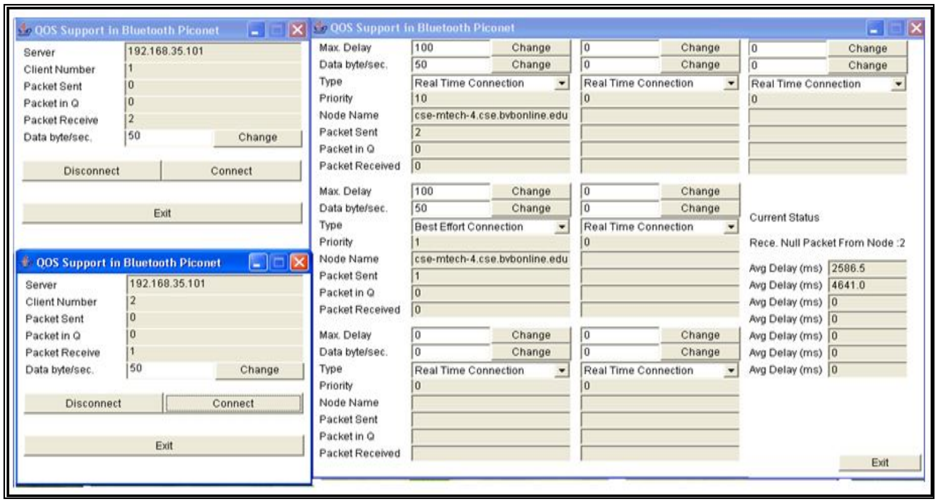

Figure 5: Simulation scenario

Algorithm	Data transmission rate in terms of byte/sec	Delay in terms of milliseconds	Percentage improvement of priority based MAC scheduling
RR	50	2586.5	44.279%
Priority based Mac Scheduling	50	4641.0	

Table 2: Simulation Result

The above Table 2 shows the comparison between the RR (Round Robin) and the encrusted algorithm based on delay to transfer packet from master to slave. Here we gave the same bite rate for both the algorithm and we analyze delay taken by each one for the transmission of packet. Our result shows the percentage of improvement by using (MAC) scheduling algorithm by taking the average delay obtained from these two algorithms.

6. Conclusion

In this paper, we projected a precedence-based layer algorithm (MAC) to Enhance Eminence Service (EES) in a Bluetooth piconet. The main contributions of this paper are: I) we showed how to program real-time slaves efficiently and provide better EES performance by using token counters to estimate their traffic; II) we demonstrated how to decline the channel bandwidth consumption caused by polling inactive slaves with applying a binary back-off mechanism for polling interval of best-effort slaves. Simulation outcome demonstrate Master Driven TDD Bluetooth piconet, our proposed approach achieved notably improved performance over RR scheme.

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