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Priority Based Polling and Scheduling Algorithm for Intrapiconets in Bluetooth

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***Abstract* - The trend of dynamically interconnecting the personal devices that people carry with them has led to the introduction of personal area networks (PANs) and personal networks (PNs). The Bluetooth wireless access technology is believed to be a potential enabler of PANs and PNs. This dissertation focuses on Bluetooth intrapiconet scheduling (also referred to as Bluetooth polling) that helps in making the Bluetooth technology a successful enabler of PANs and PNs. In order for the Bluetooth technology to be such a successful enabler, its polling mechanism should be efficient. At the same time, the polling mechanism should also be fair. Finally, the polling mechanism must be able to provide quality of service (QoS). Conventional polling mechanisms are less suitable for Bluetooth as they do not take the Bluetooth specification into account. Current Bluetooth polling mechanisms are either not able to poll in a fair and efficient manner, or they do not provide the needed QoS. The main goal of this thesis is the design of new Bluetooth polling mechanisms. To design a polling mechanism that, in case of best effort traffic, divides bandwidth among the slaves in a fair and efficient manner. To design a polling mechanism that is able to provide quality of service. These polling mechanisms help in making the Bluetooth technology a successful enabler of personal area networks, and thus of personal networks. In this research focuses on Bluetooth intra-piconet Scheduling and Reduce the time delay. It provide a better opportunity to communicate in a PAN. In this research we use Adaptive Probability-based Polling Interval (APPI) in sniff based polling mechanisms**

***Keywords*—Intrapiconet pollting,scheduling, sniff mode**

I. Introduction

Bluetooth is a radio technology targeting short- range, low-power, and low-cost wireless communications. According to the specification, a Bluetooth wireless personal area network is composed of piconets. A Bluetooth piconet is a cluster-based network unit and consists of up to eight Bluetooth devices. Among the eight devices, one is designated as the master, whereas the others serve as slaves.With a common device of two piconets, communications between individual piconets is feasible, and then, a larger scale network framework named “scatternet” is formed by multiple interconnected piconets. Such a relay device is usually called a gateway or a bridge. In a piconet, devices share the radio channel (physical channel) in a time-division manner, and data exchanges are controlled by the master. The data delivery from the master to a slave is categorized as downlink transmission,whereas that along the inverse direction is called uplink transmission.Both directional data exchanges always alternate in a time-division duplex scheme. Slot allocation is dynamic and is managed by the master node. As to the types of connections, Bluetooth supports both synchronous and asynchronous connections. Synchronous connections satisfy the nature of circuit-oriented services, whereas asynchronous connections are designed for packet-oriented services.

A slave is only allowed to send packets immediately after receiving a packet explicitly addressed to it from the master. If the slave has no data to deliver, it returns a NULL packet without user information to the master. Similarly, if the master has no packets to some slave on polling it, the master can send a POLL packet without user information to the slave. Certainly, both of these special types of packets waste bandwidth and deteriorate delay performance. As transmissions from slaves are triggered by polling actions from the master, it is necessary to equip a master with the functionality of a scheduler regarding which slave should be polled and when a polling action should be initiated. Such an activity is usually called intrapiconet (polling and) scheduling. The fewer POLL/NULL packets generated, the better the performance that an intrapiconet scheduling can achieve. The problem of how to design an efficient intrapiconet scheduling algorithm is analogous to the traditional optimization problem of polling schemes [5], except that the former one involves more constraints. For example, a master device has no knowledge of the status of uplink queues, which are located in individual slaves. Therefore, it is not feasible to apply solutions of the latter with no modification to the former.

This paper targets the design of an efficient Bluetooth polling and scheduling scheme that is adaptive to the current traffic pattern. In Section II, the polling-optimization problem is described, and we introduce several existing polling and scheduling schemes. The details of our proposed scheme will be explained in Section III. In Section IV, we demonstrate the superiority of our proposed scheme in various scenarios via simulations developed by NS-2 (an NS-2 extension module for Bluetooth). Finally, we conclude this paper in Section V.

II. Related Work

The medium access control (MAC) operations of Bluetooth could be viewed as behaviors of a single-server polling and scheduling system. The polling scheme is the set of rules that determine whether the server should switch to the next queue and the number of customers to be served in an individual visit. More specifically speaking, what concerns us about polling and scheduling schemes in Bluetooth MAC operations is how to efficiently use the radio resource. In fact, polling and scheduling schemes have extensively been studied and have been applied to solve many problems in the field of communication networks . It is proven that the exhaustive round-robin (ERR) polling policy is the optimal polling and scheduling scheme for symmetric systems, in which the distribution of offered traffic is uniform to all queues. In addition, as long as all queue lengths are given in advance, the optimal service order is obtained by following the “longest first” policy. However, in case not all queues’ status are available, the cyclic scheduling scheme would be the best choice. Comparing the system model of these discussions with Bluetooth MAC operations, there are two major differences: The first is that the visits of the server to the master-to-slave and slave-to-master queues are strictly relevant in Bluetooth as every transmission on an uplink must be triggered by a poll packet on the associated downlink. Moreover, the other distinction is the piconet master’s partial knowledge of the queues’ status. According to the Bluetooth specification, a master device would never acquire up-to-date status of slave- to-master queues whenever it is necessary. In the past few years, several algorithms have been proposed to solve the scheduling problem of Bluetooth, and some solutions impractically assumed that a master always knows the latest status (e.g., queue length, traffic load, etc.) of all uplink queues at any time. For brevity, such algorithms are categorized as ideal solutions in our work.

RR is a general polling and scheduling policy. It determines a fixed polling order, and the master addresses each slave once in that order. Just like RR, ERR serves all slave nodes according to a fixed polling order. The most evident difference between them is that ERR would continuously serve a slave until there are no data that need to be exchanged between master and slave. In fact, ERR visits each queue exactly once per cycle; hence, the cycle length can vary according to the traffic characteristics without bound. The main disadvantage of ERR is that the resource can be occupied by nodes generating traffic higher than the system capacity. The simplest way to design a fairer algorithm is to limit the number of transmissions (tokens) that can be performed by each pair per cycle. Another member of the “RR” family is limited RR (LRR) . LRR is similar to ERR, except that the former uses a parameter “t” to limit the number of transmissions performed by each pair per cycle. Intuitively, the cycle length can be determined by the maximum number of transmissions and the number of pairs. Capone *et al.* [2] concluded that ERR demonstrates the best throughput performance, compared with RR and LRR, whereas LRR outperforms the other two policies in delay performance.

Adaptive traffic polling and scheduling (ATPS) is used no statistical data are ready for referencing. Accordingly, a default procedure is predetermined for initialization This procedure sets a default sequence of slaves and identicalservice time to each slave for the first cycle. After the preliminary period, the core of ATPS, i.e., the PSD and STE algorithms, would be triggered each time a new cycle starts. During a cycle, what ATPS has to do is to identify which slave should be served at present and then to perform corresponding slave serving. For better readability, we integrate these operations to an algorithm named polling.

ATPS composed of several algorithms. Here we are using only two algorithms of it,

a) Polling sequence determination (PSD)
b) Sequence time estimation (STE)

PSD is used to dynamically determine the polling sequence in the beginning of each cycle. As previously mentioned, queue status is a significant factor of intrapiconet scheduling. The most intuitive “status” is usually the queue length. Its definition can more widely be extended. In PSD, the so-called “queue status” includes the maximum queue length and the link utilization. PSD determines the polling sequence based on the slaves’ weights.

The STE algorithm deals with the mission of service- time allocation in a cycle. The information that STE relies on includes the queue status and queuing delay. As indicated in the STE algorithm, we estimate service time according to the queuing delay of the first packet.

III. Proposed Scheme

Proposed system supports both synchronous and asynchronous connection oriented link. this system use Sniff- Based Polling and Scheduling algorithm(SBPS).Incase of best effort traffic, the design of new bluetooth polling mechanism divided bandwidth among the slaves in a fair and efficient manner .To design a polling mechanism that is able to improve quality of service. These polling mechanisms help in making the Bluetooth technology a successful enabler of personal area networks, and thus of personal networks. The polling mechanism must be suitable for providing quality of service (QoS). For instance, if a personal area network includes a Bluetooth-enabled computer, Bluetooth speakers, and a Bluetooth Internet access point, the audio you are listening to should not be disturbed by an Internet download session that you initiate. The QoS to be provided by the polling mechanism should be minimally influenced by non-ideal radio environments. For instance, if a personal area network includes a Bluetooth-enabled mobile phone and a Bluetooth headset, a phone conversation should be performed as good as possible in the presence of interference.

A. SBPS Algorithm

One of the operation modes of a Bluetooth node described in the Bluetooth specification is the sniff mode. The sniff mode is used to reduce a slave's listen duty cycle. Consequently, if a slave is in sniff mode then the master can only start transmission to that slave in specified time slots. Considering the fact that polling an inactive slave is a waste of power and bandwidth and considering the fact that switching a slave to sniff mode and back also costs power and bandwidth the main idea behind this mechanisms is to switch a slave to sniff mode whenever switching a slave to sniff mode and back costs less power and bandwidth than staying in active mode (normal operation mode).

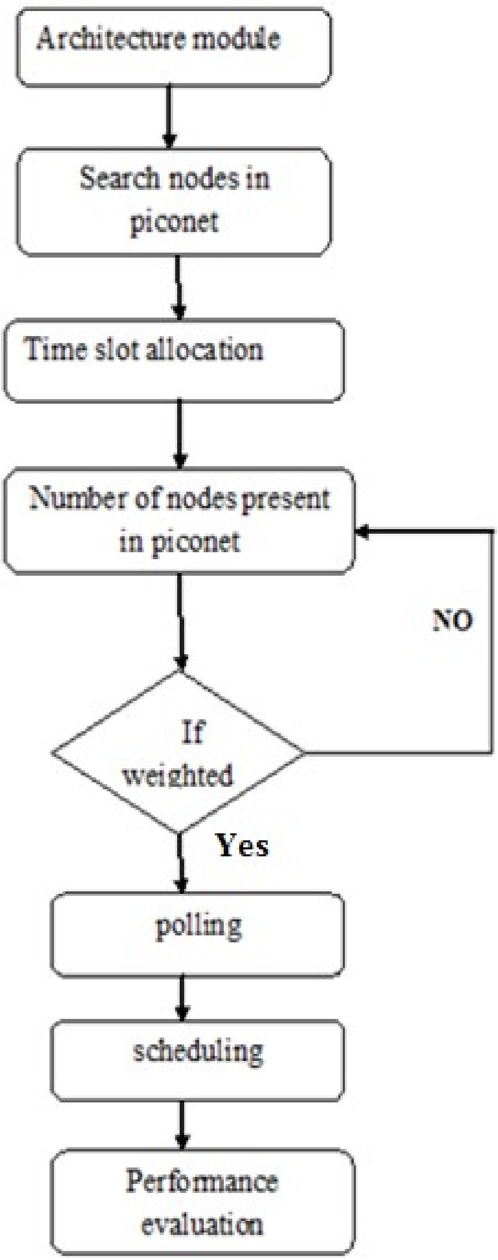

Fig. 1 Flow chart of proposed method

Assign each process a priority. Schedule the highest priority first. All processes within same priority are FCFS. Priority may be determined by user or by some default mechanism. The system may determine the priority based on memory requirements, time limits, or other resource usage. Starvation occurs if a low priority process never runs. Solution: build aging into a variable priority. Delicate balance between giving favorable response for interactive jobs, but not starving batch jobs. Each process is placed in a run-queue Allocated a service quantum of time (commonly set to 10 milliseconds) Processes that demand less time run without being interrupted Processes exceeding the service quantum are interrupted and returned to the back of the run-queue to await further processing.

B. Modules Descriptions

Bluetooth is a wireless access technology that operates in the 2.4 GHz ISM (Industrial Scientific Medical) band. Bluetooth nodes are either a master or a slave, and communication only takes place between a master and a slave, and never directly between two slaves or two masters. One master and up to seven slaves can be affiliated with each other and form a so-called piconet. Calculate the number of nodes present in the piconet then allocate the time of completion process in transaction the data. One of the operation modes of a Bluetooth node described in the Bluetooth specification is the sniff mode. The sniff mode is used to reduce a slave's listen duty cycle. Consequently, if a slave is in sniff mode then the master can only start transmission to that slave in specified time slots. Considering the fact that polling an inactive slave is a waste of power and bandwidth and considering the fact that switching a slave to sniff mode and back also costs power and bandwidth the main idea behind this mechanisms is to switch a slave to sniff mode whenever switching a slave to sniff mode and back costs less power and bandwidth than staying in active mode (normal operation mode). We use weighted priority scheduling algorithm, This algorithm first allow the weighted node means that node has high amount of data.

C. Performance Evolution

We compare SBPS with ATPS, PSD, STE on the throughput, delay, and fairness performance. Among several existing Bluetooth modules of ns-2, we used UCBT, which is a robust, flexible, and up-to-date one. In the following sections, we first describe assumptions and relevant parameter settings used in our simulation. Basically, we consider three scenarios here. Finally, we discuss the behavior of SBPS and how much gain it can achieve.

IV. Simulation Results

In our simulation, ACL connection is the only connection type that we considered. We assume that there is no limitation in queue size for all devices. As to traffic generation, we use the exponential ON/OFF traffic model to establish all data flows. The exponential ON/OFF traffic model generates data flows according to the given packet size, ON time, OFF time, and data rate. The start time of a flow is randomly determined. we proposed a new intrapiconet scheduling algorithm called SBPS. SBPS takes the queue status and queuing delay into account. More specifically, the queue status includes the maximum queue length and link utilization. Compared with other competitors,

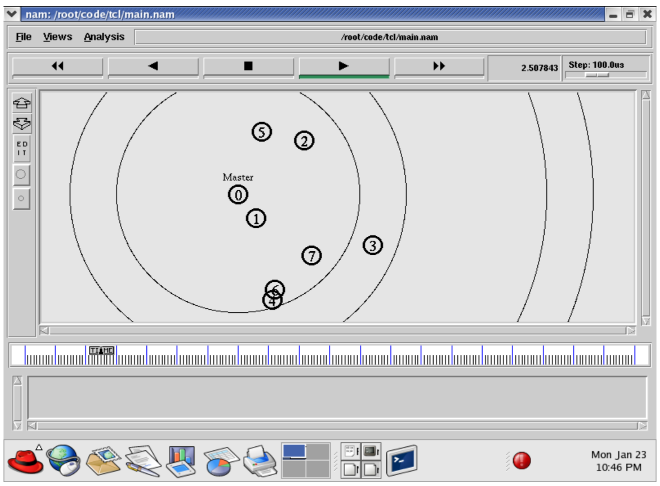

Fig. 2 Node discovery (broadcast)

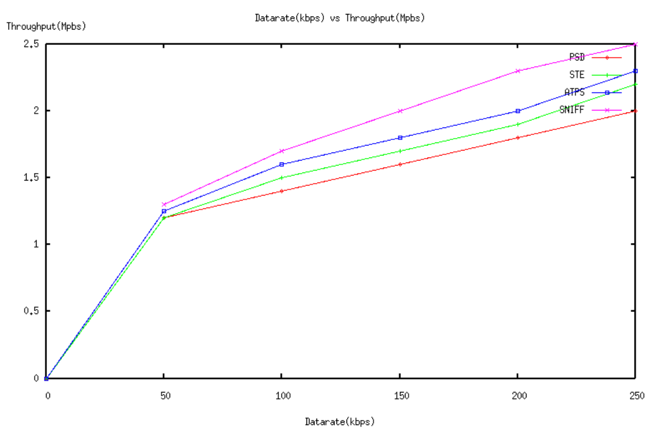

Fig. 3 Throughput Analysis

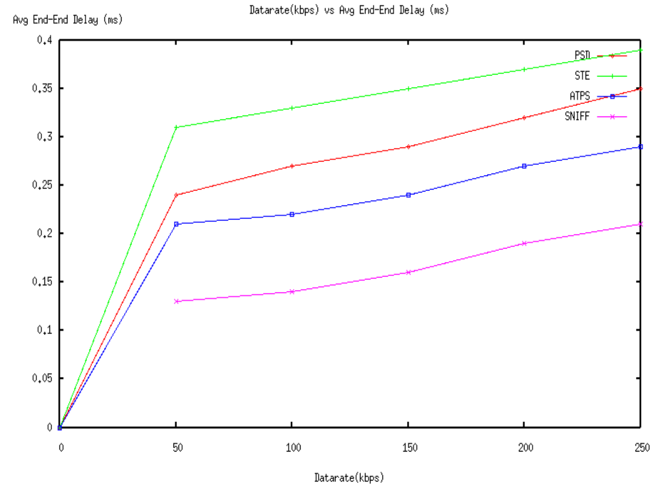

Fig. 4 End-to-End delay Analysis

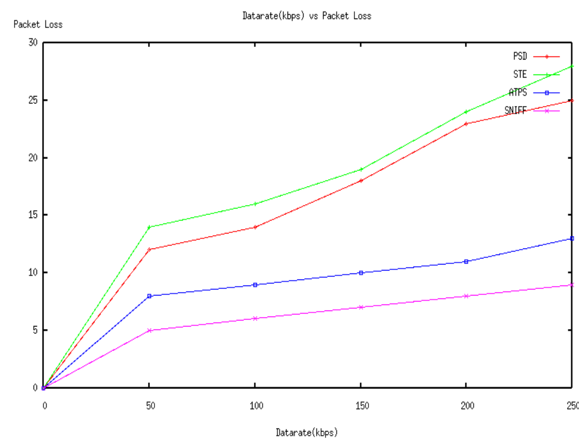

Fig.5 Packet loss Analysis

V. Conclusion

Bluetooth uses a polling mechanism, which is applied by the master, to divide the bandwidth among the remaining participants (the slaves) in a piconet. This polling mechanism, also referred to as the Bluetooth intra-piconet scheduling mechanism, highly determines the performance of the traffic flows in a Bluetooth piconet In order for the Bluetooth technology to be a successful enabler of personal area networks, the Bluetooth polling mechanism should be efficient in order to get the most out of the scarce bandwidth. At the same time, the polling mechanism should be fair, i.e., it should not ignore lowly loaded slaves. Finally, the polling mechanism must be able to provide quality of service, with the development of the polling mechanisms and techniques presented in this dissertation, the main goal of this work has been met. First, we developed a polling mechanism that is able to divide bandwidth among the slaves in a piconet in a fair and efficient manner (best effort case). Second, we developed polling mechanisms that are able to provide QoS. These polling mechanisms help in making the Bluetooth technology a successful enabler of personal area networks, and thus of personal networks.

VI. Future Work

This work focused on scheduling, which is crucial for making the Bluetooth technology a successful enabler of personal area networks. However, there are other crucial PAN- related research issues [NHdG03] such as power consumption, security, context discovery, and cooperation with fixed infrastructures. The success of the Bluetooth technology as an enabler for personal area networks also requires research to be coned on these issues.

References

[1] Ching-Fang Hsu, and Chien-Yu Liu, "An adaptive Traffic-Aware Polling and scheduling Algorithm for Bluetooth Piconet", *IEEE VTC* 2010 vol.59,no3.

[2] A.Capone, M.Gerla, and R.Kapoor, "Efficient polling schemes for Bluetooth picoells", IEEE Icc 2001. vol.7.pp1990-1994.

[3] B.S.Lee, H.W.Kim,T.U.Yang,Y.S.Park,B.H.Ahn, and J.C.Ahn, "A new efficient scheduling algorithm in bluetooth piconet", IEEE GLOBECOM, 2004,vol.6, PP. 3609-3613.

[4] Y.Z.Lee,R.Kapoor, and M.gerla, "An efficient and fair polling scheme for bluetooth", IEEE MILCOM, 2002, VOL.2, PP.1062-1068.

[5] V.B.Misic, E.W.S.Ko, and J.Misc, "Adaptive cycle limited scheduling scheme for bluetooth piconets", IEEE PIMRC, 2003, vol.2, pp.1064-1068.

[6] Y.S. Chang, S.c. Park, and S.Y.Lee, "An enhanced through put and Qos- aware scheduling policy for Bluetooth", IEEE WCNC, 2004, Vol.2.pp,1004-1007.

[7] V.B.Misic,E.W.S.ko and J.Misic, "Load and QoS-adaptive scheduling in bluetooth piconets", IEEE HICSS, 2004, pp 294-301.

[8] K.L. Chan, V.B. Misic, and J.Misic, "Efficent polling sehemes for Bluetooth picocells revisited", 37th hawaii int. Conf. Syst. Sci., Jan. 2004, pp.1004-1007.

[9] J.Misic and V.B.Misic, "Modeling Bluetooth piconet performance", *IEEE Communication Lett.*, vol.7, no.18-20, Jan 2003.

[10] M.Kalia, D.Bansal, and R.Shoreey, "Data Scheduling and SAR for Bluetooth MAC", IEEE VTC, 2000, vol.2, pp.716-720.

[11] Joao henriquekleinschmidt, marcelo E. pellenz and Luiz A.De Paula Lima Jr, "An Efficient Polling Strategy for Bluetooth piconets using channel state information", IEEE 6th CAS symp. On Emerging technologies : Mobile and wireless comm.

[12] Asmaa Ibrahim, rawyaRizk, and gamalmahmoud, "A Priority gated Round Robin polling scheme for Bluetooth piconets", *the international Arab journal of information technology,* vol.5, no.2, April 2008 .

[13] Ivan Howitt, "Mutual Interference between Independent Bluetooth piconets", *IEEE Transactions on vehicular technology*, vol.52, no.3, May 2003.

[14]. Andrea zanella, danieleMiorandi, Silvanopupolin, cristianandreola, "A soft Qos scheduling Algorithm for bluetoothpiconets".