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A NEW PROTOCOL ON BLUETOOTH SCATTERNET DESIGN

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Abstract

By interconnecting piconets into scatternets, a Bluetooth ad hoc network can be created. In forming an ad hoc network successfully, the limitations and features of Bluetooth scatternets raise unique challenges. In this article, we introduce and evaluate a new distributed randomized Bluetooth scatternet creation protocol. We show that O(log n) time complexity and O(n) message complexity are accomplished by our protocol. The scatternets created by our protocol have the following characteristics: any device is a member of a maximum of two piconets. These properties can help prevent any single device from being overloaded and lead to low piconet interference. By simulations, we validate the theoretical results, which also show that the formed scatternets have O(log n) diameter. We study the issue of interface exploration as an integral component of the scatternet creation protocol: forming several links with several Bluetooth devices simultaneously. We analyze the collision rate of the investigation and page processes and the time demand. The results of our simulation show that O(n) is the cumulative number of packets transmitted and O(n) is the maximum number of packets sent by any single computer (log n).

Keywords: *Bluetooth Network, Electromagnetic Identification (EMID), IEEE 802.11b, Routing Protocols, Scatternets.*

I. INTRODUCTION

Bluetooth is an emerging short-range radio technology which is low-cost and low-power. An ad hoc network over Bluetooth will serve many useful applications. In a meeting area, for example, a special message may be transmitted via an ad hoc network to Bluetooth-enabled cell phones and portable computers [1]. For fast deployment of EMID (electromagnetic identification) readers, Bluetooth ad hoc networks may also be used. In recent years, big research interests have gathered in the field of ad hoc networking. The routing challenges of ad hoc networks have been the subject of several reports. Typically, these studies presume that any two in-range nodes will connect with each other. It is also possible to model an ad hoc network as a graph such that the in-range nodes are adjacent. Simulation-based studies of ad hoc routing protocols, for example, were performed using a link-layer model based on the IEEE 802.11b standard or equivalent. However, an ad hoc Bluetooth-based network brings fresh challenges. In most wireless networks, there are unique

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Bluetooth restrictions not present [2]. For instance, piconets are composed of a Bluetooth network. There is one master and up to seven slaves in each Piconet. Piconets can be linked by slave sharing into a broader scatternet. Scatternet design has a huge effect on network performance. For instant, the rate of packet collisions increases when a scatternet involves more piconets. Before we can make efficient use of ad hoc Bluetooth networking, we must first formulate an effective protocol from isolated Bluetooth devices to form a scatternet [3]. This work is partially sponsored by the Auto-ID Core of MIT. In this article, in the case where the devices are in range of each other, we research the issue of scatternet forming. According to the latest Bluetooth specifications, the contact length is at least 10 meters. This implies that when the maximal distance between any two devices is at most 10 meters, our formation algorithm can work. If the expectation is not met, we will address how the algorithm can adapt. We endorse a two-layer approach to this problem. Next, we analyze how it is possible to organize these devices into scatternets [4]. We plan and test the performance of a new protocol for scatternet formation. Second, we research how the devices can easily discover each other as a subroutine of the creation protocol.

Interrelated Works:

In order to produce scatternets with such favorable properties, Miklos et al. apply heuristics. Via simulations, they test these scatternets with various characteristics. Piconet link-layer simulations are conducted by Johansson et al. In Bluetooth Scatternets, Raman, Bhagwat, and Seshan argue for cross-layer optimization. Aggarwal et al. are implementing the algorithm of scatternet creation [5]. Their algorithm divides the network into various piconets first, and then selects a "super-master" who knows all the nodes. However, since the piconets are not inter-connected, the resulting network is not a scatternet. A separate re-organization stage is required. Salonidis et al. address the challenges of a pair of Bluetooth systems communicating symmetrically. In their symmetrical protocol, with a random schedule, the machines switch states (INQUIRY and INQUIRY SCAN) [6]. In comparison, the machines switch states regularly in our work, but arbitrarily select the states. Salonidis et al. Launch a Bluetooth Topology Construction Protocol (BTCP) scatternet creation algorithm. There are three steps of BTCP:

I. The coordinator shall be chosen with full knowledge of all facilities,
II. This handler decides and advises other masters how and how to build a scatternet.
III. According to the instructions, the scatternet is formed.

For up to 36 devices, a formation scheme is presented. Our algorithm, by comparison, has only one step. Since a single computer (coordinator) determines the topology, BTCP has more freedom in building the scatternet. If the supervisor loses, however, the protocol for forming needs to be restarted. The timeout value of the BTCP for the first step would influence the likelihood of having a scatternet [7]. The timeout value of our protocol for each round only affects the overall success of the protocol established with certainty by the scatternet. Furthermore, BTCP is not ideal for complex environments where, after the scatternet is created, devices can enter and exit.

The algorithms focus on a single computer to build and inform other devices with the scatternet topology. These algorithms would then have complexity of time (n/k), where n is the number of nodes, and k is the maximum number of piconet slaves. In addition, our algorithm consists of a single stage and has a complexity of O(log n) time. As pointed out in the coordinator election

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process, however, the overall time criterion dominates [8]. Thus, unless the number of devices is very high, the benefit of the O(log n) time complexity of our protocol may not be important in operation. In addition, we note that if the topological knowledge is spread along a tree, at least step II of BTCP can be updated to run in O(log n) time. A tree-based distribution scheme can, however, increase the protocol's complexity. Tan gives a distributed Tree Scatternet Formation (TSF) protocol. Relatively low scatternet forming latency is shown by the detailed simulation performance [9]. TSF, however, is not meant to reduce the amount of piconets used. The outcomes of the simulation indicate that each master typically has less than 3 slaves. In contrast, our protocol ensures that there are at least 6 slaves for all but one of the masters. For larger-scale Bluetooth networks, Bluetree and Bluenet are scatternet creation protocols in which computers can be out of sight from each other. The simulation effects of the scatternet routing properties were discussed. However, no simulation or theoretical research on the efficiency of the method of scatternet creation was performed.

Initiations of Scatternet Design:

We add some terms and success metrics for the issue of scatternet creation in this section. Bluetooth systems use frequency hopping to exchange 79 channels of 1 MHz bandwidth in the 2.4 GHz band. One of the devices acts as a master while two Bluetooth devices are paired, and the other device acts as a slave. The position of a master or a slave can be carried out by any Bluetooth unit. Via the query process, a Bluetooth computer may discover other devices. According to a 32-channel question hopping chain, a master in the INQUIRY state hops 3,200 times per second [10]. At the same time, a slave shifts its listening frequency every 1.28 seconds in the same series in the INQUIRY SCAN state. The master knows the address (which is unique to each Bluetooth device) and the slave's clock if the inquiry process succeeds. The master and slave will then be associated with the process of the page. The master in the PAGE state contacts the slave in the page loop with a 32-channel page hopping sequence, which is a function of the address and (estimated) clock of the slave. They engage with a hopping sequence over all 79 channels at the rate of 1600 hops per second after the master and the slave are paired. The master's clock and address decide this hopping chain. A piconet consists of an active slave of 1 master and 1 k. Both packets inside a piconet are shared between a master and its slaves. No direct master-master or slave-slave correspondence occurs. In many piconets, a computer may be a slave but in just one piconet be a master. The number of piconets to which the unit belongs is the degree of a device. If its degree is 0 or 1, a computer is unshared. It is exchanged otherwise.

A scatternet is a series of piconets that are linked through shared devices. The question of creating a scatternet: How does a series of isolated devices form a scatternet? In the beginning, the devices are isolated; each computer is not conscious of the other devices. It is also important to spread the scatternet creation protocol. We assume that the systems are in each other's field of contact. Therefore, theoretically, any two systems can be directly connected. There are two key success metrics of a scatternet formation protocol:

- Complexity of time-the sum of time for creating a scatternet. To mitigate the delay faced by the users, a scatternet should be created as soon as possible.

- Complexity of the communication - the number of messages received between devices. This is critical since Bluetooth devices typically run with limited power. Power usage is preserved by reducing the number of messages received.

II. CONCLUSION

We also implemented a new Bluetooth scatternet creation protocol in this article. We provided both theoretical and simulation findings to prove that our protocol has O(log n) time complexity and O(n) message complexity. We have shown that the scatternet algorithm creates favorable properties: small numbers of piconets to mitigate inter-piconet interaction, and small degrees for network bottlenecks prevention devices. In addition, the diameter of the scatternet, which corresponds to the overall routing distance between nodes, according to the simulations, is around O (log n). Finally, we have also seen that the protocol does not especially exhaust any single unit.

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