

A Packet Reassembly and Segmentation Protocol for Low Rate Applications in Bluetooth Sniff Mode

Jiangchuan Wen and John Nelson

Department of Electronic and Computer Engineering,
University of Limerick, Limerick, Ireland
{Jiangchuan.Wen,John.Nelson}@UL.ie

Abstract. In this paper, a Packets Reassembly and Segmentation (PRAS) protocol is proposed, to be used in conjunction with the Bluetooth sniff mode, to re-assemble small host controller interface (HCI) (ACL) data packets to larger ones so that the link controller can use a larger baseband packet type (e.g. 3-DH5) as appropriate. The associated Bluetooth operations and control procedures of the PRAS protocol are given. The analysis shows that this protocol reduces Bluetooth's use of small size baseband packets and significantly enhances packet transmission efficiency with lower overhead in Bluetooth sniff mode.

Keywords: Bluetooth, Packets Reassembly and Segmentation protocol, Sniff mode, Packet transmission efficiency, Wireless Sensor Networks.

1 Introduction

Nowadays, Bluetooth [1] devices frequently have to use small payload packets to deliver low rate data in WSNs and waste energy by performing the required polling operations to maintain channel synchronization. Sniff mode is a low power mode on a Bluetooth BR/EDR Controller, which can reduce the unnecessary polling operations and allow devices to enter a low power state. The Bluetooth protocols don't provide the opportunity to take full advantage of sniff by adopting more efficient baseband packet payloads. Hence, a new protocol is required and the result is the Packets Reassembly and Segmentation (PRAS) protocol.

2 The PRAS Protocol

The kernel PRAS protocol functionality is as follows: 1) when the Bluetooth device uses sniff mode and the BR/EDR controller caches small size HCI ACL data packets, the link manager (LM) can re-assemble the small size packets before delivery; 2) when the Bluetooth receiver receives a re-assembled packet, it can be segmented and restored to the original small size HCI ACL data packets; 3) the operations above shall be negotiated by a LM command and implemented in the controller.

3 LMP Negotiation and Re-assembled Packet's Identifier

The PRAS protocol can be an extended feature in the BR/EDR controllers by a new LM Protocol (LMP) command LMP_PRAS. The re-assembled packet shall be encapsulated in a Bluetooth baseband packet and identified by the other Bluetooth device. We recommend using an LLID value of '00' in the payload header, which is currently undefined in the Bluetooth standard, to indicate that a re-assembled L2CAP message is being transported in the payload.

4 Packets Reassembly and Segmentation Process

During the sleep slots of the sniff interval period, the PRAS protocol re-assembles the HCI ACL data packets stored in a buffer for each common user ACL link (ACL-U). The payload re-assembly process in the baseband buffer is shown in Fig.1.

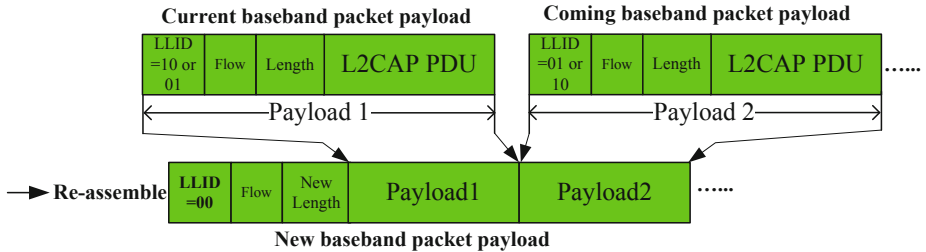


Fig. 1. The PRAS protocol payload re-assembled process

When the controller receives a packet with the LLID set to '00', the LM and HCI shall segment the packet's payload and restore the original packets.

5 Evaluation the PRAS Protocol and Conclusion

This protocol transparently exchanges the L2CAP PDUs and it doesn't affect other operations (e.g. encryption) in the LMP. The overhead of PRAS protocol is very low and only adds a two byte payload header.

The target application is low rate data Bluetooth-based sensor networks. The PRAS protocol can reduce the number of slot operations of the Bluetooth BR/EDR controller and enhance packet transmission efficiency, thereby improving power efficiency with sniff mode.

Reference

1. Bluetooth SIG.: Specification of the Bluetooth system, Version 4.0. (2010)