Simulation Results of Random Access MAC over a Frequency Hopping Radio Channel

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Two major frequency hopping radio technologies, Bluetooth and 802.11 FH, have emerged to provide wireless LAN or PAN (Local or Personal Area Network) connectivity. Even though both are frequency hopping radios they are different in many aspects.

In Bluetooth frequency hops as well as packet transmissions are aligned to time slots, where a packet can be one up to five slots in length. There is no frequency hop during a packet transmission. In Bluetooth the nodes maintain a common channel by forming a piconet. In each piconet there is one master and up to seven slave nodes. Every unit in the piconet uses the master address and clock to select the appropriate frequency used in the corresponding slot. Between nodes two types of link have been defined: the synchronous connection-oriented (SCO) link typically for voice traffic and the asynchronous connectionless (ACL) link typically for bursty data transmission. The SCO links are pre-allocated, while ACL connections are controlled by the master unit using a polling mechanism. Communication is enabled only between master and slave devices.

The 802.11 protocol handles several physical layers (direct sequence spread spectrum, infrared besides frequency hopping), but the MAC protocol is the same. In 802.11 every node can communicate with the others using a random access method to start data exchange. This random access method is a four-way handshaking mechanism consisting of request to send (RTS), clear to send (CTS), data and acknowledgement (ACK) packet. If a node wants to send data, it first sends a RTS packet to the destination. The destination node answers with a CTS packet. After a successful RTS-CTS exchange, the source transmits the data packet to the destination and waits for an acknowledgement (ACK). If no ACK received the source retransmits the packet. The transmission ends if the ACK of the last data packet is received. During packet transmission the carrier frequency may change, not like in Bluetooth.

We investigated a new protocol that is different from both of the protocols above. We use the piconet concept from the Bluetooth and the random access MAC from the 802.11. As an advantage, the random access protocol are easy to implement and yet it provides on demand resource allocation. The potential disadvantages are that it can not handle QoS, and in case of big load there are many collosions which decreases radio channel utilization.

We have created a simulator prototype of this new protocol. We are currently investigating the effects of external interference and how the packet size influences the throughput.