Socket Bluetooth Card

Theory of Operation

Bluetooth is an open standard developed by four OEM's (Ericsson, Nokia, IBM, and Toshiba) and one semiconductor company (Intel). The standard aims to define a globally accepted short distance (10m/30ft) radio communication protocol using a part of the radio frequency that is unlicensed (i.e. free to use) in most parts of the world. Bluetooth's key characteristic is that enabled devices can detect and communicate with other enabled devices within range – all without conscious user intervention.

The Socket Bluetooth Card is a small Compact Flash size card that plugs into any standard CF+ socket on Pocket PCs, PDAs, etc. It contains an interface that meets of the standards for a Compact Flash card. The card operates like an I/O device to the host processor. It also contains a radio transmitter and receiver that meets the requirements defined in the standards published by the BlueTooth Special Interest Group.

The combination of the Compact Flash interface, radio, along with associated BlueTooth software stack, and application software provides a convenient way for the host platform to wirelessly interact with various devices such as mobile phones, printers, etc.

The radio part of the Socket card is specified in the BlueTooth open standard. It operates in the frequency band of 2402 to 2480 Mhz at a radiated power level of .001 watt. It radiates using Gaussian Frequency shift keying and uses frequency hopping spread spectrum on 79 equally spaced channels. All channels are 1 Mhz apart and hop through the channels using a pseudo-random hopping sequence. The device hops from channel to channel at a rate of 1600 hops per second. The radio is completely controlled by the associated software stack and application program. The stack controls the hopping sequence, and protocols for establishing a connection with other BlueTooth devices in the near vicinity.

1. Derivation of the pseudorandom hopping sequence.

Hopping sequence selection for a system is controlled by the master unit within a specific system. The sequence is selected by a combination of address codes and master unit system clock. The pseudo-random sequence is generated in a nine-stage shift register whose 5^{th} and 9^{th} stage outputs are added in a modulo-two addition stage with the result fed back to the input of the first stage.

This produces a pseudo-random sequence length of 31 bits for page and inquiry modes and provides for transition to a 511 bits pseudorandom sequence length for data mode of operation. The following are two examples of possible 79 channel hopping sequences with channels identified as 1 through 79. The channel numbering scheme starts with channel 2 at 2402 MHz with the 79^{th} channel then appearing at 2480 MHz as channel 80.

Sequence a:

2,17,68,55,4,77,56,27,70,80,22,33,57,34,29,79,44,50,3,71,66,36,78,20,67,30,24,11,37,69,
23,7,41,38,63,14,31,59,40,13,6,25,65,15,61,73,58,47,19,28,54,76,74,48,52,75,5,42,64,72,
62,51,60,18,45,53,16,39,46,32,49,43,8,21,9,12,10,26,35

Sequence b:
50,6,41,57,64,14,42,33,79,3,20,38,56,69,75,21,80,23,31,40,45,68,32,28,4,15,34,59,71,61,
70,5,72,13,48,70,39,54,78,7,77,62,30,2,8,55,10,63,12,16,37,11,43,66,25,51,58,74,17,47,
9,29,65,19,53,18,52,36,27,26,44,22,49,24,35,60,73,76,67

2. Use of each frequency equally on average.
The FHS (frequency hop selection) packet is transmitted by a sending unit.
It contains UAP (upper address part)/LAP (lower address part) as well as clock information which is updated before retransmission in the inquiry state. When in hybrid substate, the UAP/LAP is used together with the clock to select the sequence. The output from the selection box constitutes a pseudo-random sequence covering 79 hops for US operation. For inquiry mode, the selection scheme chooses a segment of 32 hop frequencies from the 79 hops spanning about 64 MHz and visits these hops once in a random order. Next, a different 32-hop segment is chosen, etc. Refer to chapter 11 of the Bluetooth specification for a more through explanation of the hopping structure.

3. Receiver matching bandwidth and synchronization.
The receiver bandwidth is 1 MHz in the data mode. During connection establishment, the master identity and clock are transferred to the slave unit so it can synchronize to the channel.
The master clock in a slave unit is obtained by adding an offset to the internal clock of the slave. Also see above item 1 for details on the master clock and pseudo-random hopping channel selection.

4. Antenna.
RF energy is radiated from the card through an antenna that is completely contained within the card with no ability to attach an external antenna.

5. More information.
The current BlueTooth specification version 1.1 is available to anyone at no cost from the BlueTooth SIG, Inc. website at http://www.bluetooth.com/ . The specification is in two sections, the CORE specification and the Profile specification. Both sections together are approximately 1500 pages.