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Pt 15.247(a)(1) requires that;
"The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals."

## 1. Pseudorandom Hop Sequence

The pseudorandom sequence is generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage with the result fed back to the input first stage. This produces a pseudorandom sequence length of 31 bits for page and inquiry modes and provides for transition to a 511 bit pseudorandom sequence length for data mode of operation.

For connection state the inputs to the shift register are determined by the address and clock of the Master unit in the connection. The address is a unique 48 bit identifier for the unit, and the clock is a 27 bit counter.

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 2402MHz and with channel the 79th at 2480MHz as channel 80.

Sequence one :-
3,18,69,56,5,78,57,28,71,81,23,34,58,35,30,1,45,51,4,72,67,37,79,21,68,31,25,
12,38,70,24,8,42,39,64,15,32,60,41,14,7,26,66,16,62,74,59,48,20,29,55,77,75,49,
53,76,6,43,65,73,63,52,61,19,46,54,17,40,47,33,50,44,9,22,10,13,11,27,34

Sequence two :-
49,5,40,56,63,13,41,32,78,2,19,37,55,68,74,20,79,22,30,39,44,67,31,27,3,14,33,
58,70,60,69,4,71,12,47,69,38,53,77,6,76,61,29,1,7,54,9,62,11,15,36,10,42,65,22,
50,57,73,16,46,8,28,64,18,52,17,51,35,26,25,43,21,48,23,34,59,72,75,66

## 2. Frequency usage

The hopping sequence is unique for the connection and is determined by the address of the Master unit in the connection. The clock of the Master determines the phase in the hopping sequence. In any transmission where the whole sequence is not used, the next transmission will start at a random point in the sequence, solely determined solely by time elapsed on the Master clock. This means that in a series of short transmissions the starting frequency (within the fixed repeating sequence unique to the Master) of each transmission is determined by the Master clock, and will normally be different each time. In fact the hop frequency at a fixed time from the start of the connection will be the same whether there is one long transmission or a series of short transmissions. Therefore, on average a series of short transmissions at random times will occupy all channels equally, since the start frequency is determined solely by time elapsed.

3. Receiver matching bandwidth and synchronization

The receiver bandwidth is 1 MHz.

When a connection is made the Slave device receives information about the Master address and clock state. Periodically during the connection state the Master and Slave clocks are synchronized. The Slave therefore has the same information as the Master for determining the hop sequence and phase. The Master and Slave are therefore able to calculate separately the same hop sequences for their transmitters and receivers throughout the connection. Thus the receiver is able to track the transmitter hops and stay in synchronization.

The transmitter and receivers physically shift frequency by the baseband software controlling a Voltage Controlled Oscillator, which shifts frequency within the allowed channels.

If a packet is corrupted or not received it can be retransmitted, but it is treated as a new packet as far as the hopping sequence is concerned. That is the same hop frequency is not used, the next hop frequency in the sequence is used. For packets that occupy more than one time slot (of 625 microseconds) the same frequency is used throughout the packet. However, for the reasons given above the hop frequency at the start of the next packet is purely related to elapsed time on the Master clock, so a sequence of multi-slot packets at random times will on average occupy all channels equally.

Pt 15.247(g) requires that;

"Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section."

This is covered in 2 above.

Pt 15.247(h) requires that;
"The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted."

The hop sequence is generated independently by the Master from its Bluetooth Device Address, and the hopping sequence is determined by the Bluetooth clock of this same Master. As the Bluetooth Device Address is unique to a particular device, there is no mechanism for coordination of hop frequencies to avoid multiple occupancy. No Master unit has any freedom to vary the mechanism by which the hop sequence and phase is determined. The unit address is fixed during manufacture and the clock circuitry and hop sequence generation is performed in hardware, which cannot be controlled by the unit.

The above responses were from CSR to FCC Application Processing Branch dated 07 May 2001. Futhermore since the Device under Review is a CSR Blutooth Intergrated Circuit and uses the same Lower Stack all information will be the same.