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VConnect (Digital Wireless Audio Module) Operation Writeup

The VConnect (Digital Wireless Audio Module) uses 2.4GHz Bluetooth Class 1 radio transceiver together with a baseband that employed an intelligent frequency hopping algorithm for interference avoidance called Advance Adaptive Frequency Selection (AAFS). The AAFS algorithm will test a frequency channel for interference before commencing audio data transfer. Once interference is detected during its audio data transfer process, it will exit the existing channel and switch to another unused channel.

The audio transmitter is termed as a master module while an audio receiver is termed as a slave module. Both the master and slave modules are radio transceivers and they maintain synchronisation through the exchange of control data in the wireless communication protocol. The master module is in transmission for about 75% before it switches to receiver mode. Similarly the slave module is in transmission for about 25% before it switches to receiver mode. Both the master and slave modules are defined and matched by an unique 28-bit device ID address.

In the master module, the module input analog audio signal is converted into digital format through an Analog to Digital Converter (ADC). The digital audio is input into the baseband for digital processing. In the baseband, the digital audio is compressed by 4 times and formatted into packets for transmission. In the slave module, once the audio data packet is received via the RF transceiver, the audio data packets are verified using Forward Error Correction (FEC). The verified audio packets are uncompressed and output in digital audio format from the baseband. Using a Digital to Audio Converter (DAC), the digital audio is converted into analog audio as the module's output.

When both the master and slave modules (with the same device ID address) are powered on, they will execute a channel scan mode to locate an unused frequency channel in the 2.4GHz ISM band. Within the 79 channels available in the 2.4GHz band, 10 pre-defined channels are not used for module pairing but are used during the channel scan mode. Both the master and slave modules will hop in a pseudo-random sequence to locate each other and will eventually pair on one of the 69 channels.

After the paired modules have established a reliable communication channel (primary channel) and have begun audio content transfer, the paired modules will continuously monitor the wireless communication link quality. After about every 5ms of transmission on the primary channel, they will search and switch to another frequency channel (secondary channel) to test its wireless link quality. Thereafter the modules will hop back to the primary channel to continue audio transfer.

If an interference source occupies the same channel, the existing channel becomes unreliable and the error detection from the FEC block exceeds a preset error threshold. The modules will immediately and automatically hop to the secondary channel which will now become the primary channel for audio content transfer.

Over a period of time, there will be equal usage of the frequency channels by the modules because the interference source may also hop or exist intermittently. And the communication channel will not remain unchanged for more than 400ms.