Kleer Advantages Over Bluetooth

Kleer
KLR0000-WP3-1.0
December 12, 2007

Introduction

This whitepaper compares Kleer technology to Bluetooth technology for the application of wireless streaming audio.

How does the Kleer wireless technology compare to Bluetooth?

Bluetooth is a standard for relatively short-range general-purpose data communications. Bluetooth has found initial market success in wireless voice headsets for mobile phones and is now trying to address stereo audio for mobile phones and portable audio players. Bluetooth solutions suffer from poor audio quality due to the use of lossy audio compression, poor ISM (2.4GHz) band coexistence performance in high interference environments, and high power consumption when carrying streaming audio.

Kleer's technology is optimized for high quality wireless audio transmission between portable audio devices. Kleer's patented sub-sampling radio architecture combines lossless audio transmission, low-power consumption, low latency, and best-in-class ISM band co-existence to provide far superior audio quality with up to 10 times the battery life of a comparable Bluetooth solution.

What are the specific advantages of Kleer technology over Bluetooth?

- Kleer's ultra-low power consumption achieves up to 10 times the battery life of a comparable BT solution. Such low power consumption enables OEMs to integrate wireless technology into portable audio players without suffering a large penalty in battery life. And OEMs can introduce new small form factor products such as wireless earphones knowing that small batteries will still give them acceptable battery life. For example, Kleer has a reference design for small form factor wireless earphones that achieves 5 hours of battery life. A BT solution using the same battery and form factor would achieve less than one hour. Thus BT solutions must use bigger batteries that force them into larger form factor designs.

- Kleer's lossless transmission of 16-bit, 44.1KHz-sampled stereo audio delivers full CD-quality audio. BT has much less bandwidth available to carry audio than Kleer, and therefore must use lossy audio compression to reduce the audio bandwidth. The only audio compression mechanism mandated by the BT standard is Sub-Band Codec (SBC) which substantially reduces audio quality and increases audio latency.

- Kleer's best-in-class 2.4GHz band co-existence dynamically selects one out of 16 narrowband ($<$ 3MHz) channels, each of which can fit in the gaps between wireless LAN channels. BT uses frequency hopping spread spectrum and must find at least 20MHz of radio spectrum (20 x 1 MHz channels) to carry music.

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This makes it much more difficult for BT to avoid interference from, and interfering with, other 2.4GHz radios such as wireless LANs, cordless phones, baby monitors, Zigbee, etc. And finding this much spectrum is only getting more difficult. Wireless LANs are spreading out across the 2.4GHz spectrum in an effort to avoid interfering with each other, and new wireless LAN standards such as 802.11n are occupying more spectrum to get more bandwidth. These developments make it increasingly impossible to find 20MHz of available spectrum.

- Kleer's Listen In™ technology enables users to share the listening experience by having multiple wireless earphones, headphones or speakers listening simultaneously to the same audio source. Standard BT cannot support more than one streaming audio connection.

- Kleer's currently supports audio latency down to 45msec and eventually 20msec. BT solutions require larger audio buffers in order to perform lossy compression and to deal with 2.4GHz radio interference. For BT, the latency associated with these buffers is typically more than 100msec. This much latency is unacceptable for video and home theater applications.

- Kleer's technology is a complete solution, not dependent on an external host controller with complex protocol software. Kleer's embedded firmware implements all aspects of the radio protocol, including wireless link management (pairing and connecting devices), 2.4GHz co-existence management, audio transport, and remote audio playback control. BT is a complex protocol, requiring time and cost to develop and certify, and usually requiring 50MIPS or more from an external host to execute.

- Kleer's technology guarantees interoperability, because all functions affecting interoperability are implemented in Kleer's hardware and firmware. Of course, BT is a standard that in theory guarantees interoperability. However, it is left to the consumer to ensure that they have the right BT profile to achieve interoperability. And, as is mentioned further below, some BT technology companies are introducing features that are not mandated by the BT standard, but will only work if both ends of the link support the feature.

How does Kleer substantiate a claim of 10 times the battery life of a comparable Bluetooth solution?

Measurements on Bluetooth 1.2 and 2.0 stereo audio headphones available on the market today show power consumption of approximately 150mW. Kleer's power consumption is currently 30mW which is a factor of 5 times less. However, this is not an apples-to-apples comparison because Kleer is carrying 3-4 times the data rate. Bluetooth uses lossy compression to reduce the audio data rate to 350Kb/s whereas Kleer carries the full 1.4112Mb/s. This is why Kleer's audio quality is so much better. Kleer estimates that a

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Bluetooth solution carrying 1.4Mb/s streaming audio would consume at least 300-400mW and this is the basis of the 10X claim.

What is the impact of Kleer's technology on the battery life of portable media players compared to Bluetooth?

A state-of-the-art portable audio player with a 400mAHr battery can achieve a battery life of 27 hours of continuous playback using a wired earphone. This corresponds to a power consumption of about 55mW. Approximately 10-15mW of this is consumed by the audio DAC and earphone amplifier. When you add a Bluetooth interface to this player, the battery life drops to about 7 hours. When you add a Kleer interface to this player, the battery life is still over 21 hours.

How is Kleer extending battery life over solutions offered by the competition?

The basis of Kleer's ultra-low power consumption is the company's patented sub-sampling radio architecture. A conventional direct conversion or low-IF radio receiver requires an RF PLL and two signal paths (I-phase and Q-phase) each with a mixer, filter and ADC to convert the incoming signal to a baseband digital signal for further processing. This high frequency analog circuitry consumes a lot of power. Kleer is able to perform the RF to baseband down conversion and analog to digital conversion in one step using a sub-sampling ADC. This architecture has only a single signal path and eliminates the RF PLL and mixers, substantially reducing the power consumption of the receiver.

Kleer is building on this base to increase our advantage over Bluetooth. Kleer is committed to drive reduced power consumption over subsequent generations of product introductions. Kleer will take full advantage of available techniques, including firmware optimization, duty cycle reduction, and process geometry shrinks.

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