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PROVISIONAL APPLICATION FOR PATENT COVER SHEET (Large Entity)

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53 (c).

INVENTOR(S)/APPLICANT(S)

Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
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☐ *Additional inventors are being named on page 2 attached hereto*

TITLE OF THE INVENTION (280 characters max)

BLUETOOTH CLEAR CHANNEL ASSESSMENT

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☐ Customer Number → *Place Customer Number Bar Code Label here*

OR

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ENCLOSED APPLICATION PARTS *(check all that apply)*

☒ Specification	*Number of Pages*	5
☐ Drawing(s)	*Number of Sheets*	
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The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government

☒ No

☐ Yes, the name of the U S. Government agency and the Government contract number are:

Respectfully submitted,

SIGNATURE [signature]

DATE 1/10/2000

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USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

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Bluetooth Clear Channel Assessment

of

Steve Shellhammer

Bluetooth is a new wireless personal area network (WPAN) specification operating in the 2.4 GHz ISM band. This is the same band in which IEEE 802.11 wireless local area networks (WLAN) operate. Bluetooth uses a Frequency Hopping Spread Spectrum (FHSS) radio, which hops much faster than most IEEE 802.11 radios. Bluetooth sends a short packet as it dwells on a given frequency. Most IEEE 802.11 radios hop much slower and send much longer packets. Also there are versions of IEEE 802.11 WLANs that use Direct Sequence Spread Spectrum (DSSS) which do not hop and occupy a wide band.

As a result, during the transmission of an IEEE 802.11 packet the Bluetooth radio hops across many frequencies and potentially sends a packet on each frequency. These Bluetooth packets interfere with the IEEE 802.11 packets and cause the IEEE 802.11 packet to be in error. The IEEE 802.11 packet needs to be retransmitted, and once again may be destroyed by the signal from the Bluetooth radio. The challenge is to develop a method to prevent the Bluetooth radio from interfering with the IEEE 802.11 radio.

This technique could be used in any Bluetooth radio and in any device that will operate in an IEEE 802.11 WLAN environment. Since it detects devices radiating in the 2.4 GHz ISM band it could also be used to prevent interference with other devices in that band.

Background

A Bluetooth network consists of up to eight Bluetooth devices operating in a piconet. The piconet has one master and up to seven slaves. All the Bluetooth devices in the piconet hop in unison, at a rate of 1600 hops/second. The time that the frequency hopper dwells on a given frequency is called the slot time. At this hop rate the slot time is 625 microseconds. Typically packets are completed within one slot time; however, it is also possible to have 3 and 5 slot packets. The master and the slaves take turns transmitting, with the master transmitting on even slots and the slaves transmitting on odd slots. See also Bluetooth Specification, version 0.9, May 10, 1999, which is hereby incorporated by reference in full

There are two types of links between the master and each of the slave devices in a Bluetooth piconet. There is an asynchronous connection-less link (ACL) which is used to transfer data. There is also a synchronous connection oriented link (SCO) that is used to transfer voice data. The master in the picolink determines when data on an ACL link is transferred. Data is transferred when the master has data to send to a slave or the master wants to receive data from a slave. Data on an SCO link is transferred on a periodic basis once the link has been established. This SCO link is intended to support real-time data, like voice data.

This disclosure addresses the issue of interference with an IEEE 802.11 WLAN by a Bluetooth picolink. There is no known method of preventing SCO packets from interfering with an IEEE 802.11 WPAN since SCO packets are sent on a regular periodic basis. However, this disclosure describes a method in which a Bluetooth piconet that only supports ACL packets can be made to minimize its interference effects on an IEEE 802.11 WLAN.

That means that a piconet of Bluetooth devices that are intended to send data only, and not voice, traffic can be made to exist in an IEEE 802.11 WLAN environment without severely impacting the WLAN performance.

<u>Current Bluetooth Transmission Protocol</u>

Each Bluetooth device within a piconet frequency hops in unison, according to a pseudo random sequence. Figure 1 illustrates each device hopping along its sequence of frequencies: f(1), f(2), … f(n)… The figure also shows how the 625-microsecond slot time includes a 220-microsecond period for the frequency synthesizer in the radio to retune to a new frequency.

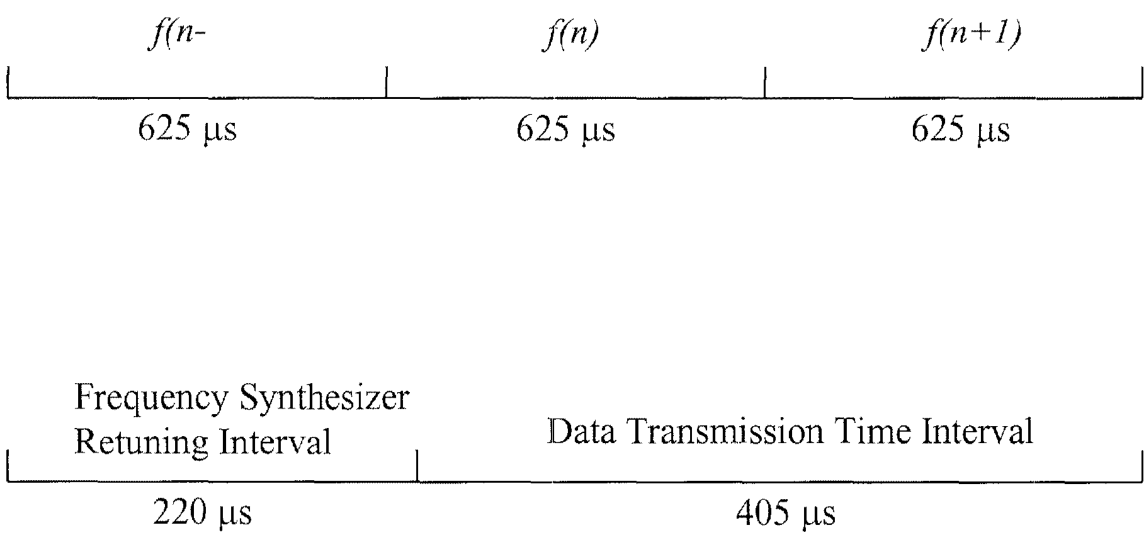

Figure 1: Conventional Bluetooth Time Slot

Notice that the 625-microsecond slot is divided into a 220-microsecond interval in which the frequency synthesizer is retuned to a different frequency and a 405-microsecond interval in which data is transmitted.

As stated above during even slots the master transmits to a slave and during odd slots the slave transmits back to the master. The master can transmit on any even time slot. The slave can only transmit to the master in a time slot if the master sent the slave a packet in the previous time slot. Thus the master determines which slave can send data and in which time slot. If the master does not send data to any slave in slot n then no slave can transmit in slot (n+1). The exception to this rule is for SCO link packets in which data is always transmitted in predefined periodic intervals. So for ACL links if the master does not transmit any data the slaves do not send any data.

Proposed Extension to Bluetooth

Currently the piconet master does not attempt to determine if any other devices are using the spectrum before it transmits. As a result, if there is an IEEE 802.11 packet currently being transmitted the Bluetooth master will not bother to check to see if this other system is transmitting and will itself transmit at the same time, and possibly on the same frequency. As a result it will interfere with the IEEE 802.11 packet possibly causing the packet to be received incorrectly.

In this disclosure it is proposed to subdivide the 220 microsecond time interval into several subinterval and to spend some of that time looking ahead into subsequent frequencies to see if there is any other devices transmitting in those channels. The reason to look ahead is that if the a master sends a message to slave #1 on frequency f(n), then the

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