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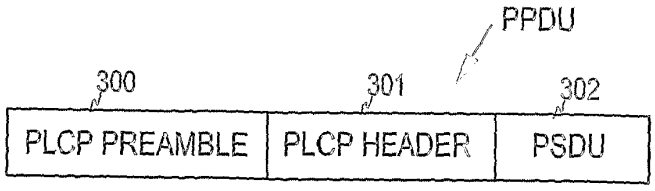
(54) Title: REDUCTION OF POWER CONSUMPTION IN WIRELESS TERMINALS



(57) Abstract: The invention relates to a method for decreasing power consumption in a wireless terminal intended for a short-range wireless communication system. In the method the standard MAC functionality of a wireless terminal is modified so that packet transaction times become shorter thus reducing the power consumption and giving the terminal more time for the power save mode. This is accomplished by increasing the transmission rate of physical layer data units comprising a preamble, a header, and a payload portion so that the header is transmitted at a transmission rate higher than what is standardized for the header. The transmission rate of the header is preferably increased to the highest transmission rate standardized for the payload portion. In further embodiments of the invention further modifications of the MAC functionality are introduced, the embodiments further decreasing the packet transaction times.

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REDUCTION OF POWER CONSUMPTION IN WIRELESS TERMINALS

Field of the Invention

The invention relates generally to wireless terminals intended for short-range, beacon-based communication systems. More particularly, the present invention concerns a mechanism for decreasing power consumption in wireless terminals engaged in short-range, beacon-based communication.

Background of the Invention

The current development towards truly mobile computing and networking has brought on the evolvement of various access technologies that also provide the users with access to the Internet when they are outside their own home network. At present, wireless Internet access is typically based on either short-range wireless systems or mobile networks, or both.

Short-range wireless systems have a typical range of one hundred meters or less. They often combine with systems wired to the Internet to provide communication over long distances. The category of short-range wireless systems includes wireless personal area networks (PANs) and wireless local area networks (WLANs). They have the common feature of operating in unlicensed portions of the radio spectrum, usually either in the 2.4 GHz Industrial, Scientific, and Medical (ISM) band or in the 5 GHz unlicensed band.

Wireless personal area networks use low cost, low power wireless devices that have a typical range of about ten meters. The best-known example of wireless personal area network technology is Bluetooth, which uses the 2.4 GHz ISM band. It provides a peak air link speed of one Mbps, and power consumption low enough for use in personal, portable electronics such as PDAs and mobile phones. Wireless local area networks generally operate at higher peak speeds of 10 to 100 Mbps and have a longer range, which requires greater power consumption.

Wireless LAN systems are typically extensions of a wired network, providing mobile users with wireless access to the wired network. Examples of wireless local area network technology include the IEEE 802.11a, which is designed for the 5 GHz unlicensed band, and uses orthogonal frequency division

multiplexing (OFDM) to deliver up to 54 Mbps data rates; the 802.11b, which is designed for the 2.4 GHz ISM band and uses direct sequence spread spectrum (DSSS) to deliver up to 11 Mbps data rates; and the HIPERLAN Standard, which is designed to operate in the 5 GHz unlicensed band.

In wireless LAN technology, two basic network topologies are available for network configuration: an ad-hoc network and an infrastructure network. An ad-hoc network is formed by two or more independent mobile terminals without the services of a base station, i.e. in an ad-hoc network the terminals communicate on a peer-to-peer basis. An ad-hoc network is normally formed for temporary purposes. The infrastructure network, in turn, comprises one or more wireless base stations, called access points, which form part of the wired infrastructure. In a typical network of this type, all traffic goes through the access points, regardless of whether the traffic is between two terminals or a terminal and the wired network, i.e. the mobile terminals do not communicate on a peer-to-peer basis. The mobile terminals are provided with wireless LAN cards, whereby they can access the wired network or set up an ad-hoc network.

So far, WLAN (wireless LAN) technology has been used mainly in laptop computers, which are typically AC powered, but which may also be used in battery mode that provides a fairly high battery capacity. To prolong the life of the batteries, the WLAN standards define a specific power save mode into which the terminals may enter in order to decrease their power consumption. In this mode the WLAN-specific power consumption is very low, but the terminals have to wake up (i.e. enter the active state) periodically to receive regular beacon transmissions broadcast in the network. The beacon transmissions indicate, for example, whether there are incoming packets buffered for a terminal. If so, the terminal retrieves the packets, goes back to sleep, and wakes up again to listen to the next beacon transmission.

The current WLAN power management has been designed assuming that the terminal devices are laptop type computers featuring a relatively high battery capacity. Along with the generalization of various other types of personal communication devices, such as intelligent phones, having a smaller size and thus also a lower battery capacity than laptop computers, power consumption has, however, become a critical issue when new properties are designed for

wireless systems and terminals. This development work is complicated by the fact that the capabilities of legacy terminals must be taken into account, which often translates to some sort of compromise. Emerging ad-hoc mode applications in which power consumption may be rather high further aggravate the problem. Examples of such applications are games played in small groups or business meetings in which large files may be shared (wirelessly) by the terminals.

The present invention seeks to accomplish a solution by means of which the above drawbacks can be alleviated or eliminated.

Summary of the Invention

The present invention seeks to devise a new mechanism for decreasing the power consumption in wireless terminals operating in short-range, beacon-based communication systems. The invention also seeks to bring about a MAC (Media Access Control) layer functionality which is optimized in terms of power consumption and which is particularly suitable for close proximity communication in ad-hoc networks where beacon frames are broadcast.

In the present invention, a wireless terminal is provided with a modified MAC layer functionality as compared to a standard WLAN terminal. The starting point of the invention is thus a standard WLAN functionality. This functionality is modified by shortening the transmission intervals of the terminal. The transmission of the physical layer frame is accelerated, contrary to the standard WLAN operation, so that the frame header is transmitted at the same high bit rate as the payload portion of the frame. This modification translates to shorter packet transaction intervals and to lower power consumption, while also allowing the terminals more time for the power save mode.

Thus one embodiment of the invention is the provision of a method for decreasing power consumption in a wireless terminal intended for a short-range communication system according to predefined system specifications, in which system beacon frames are broadcast at beacon intervals. The method includes the step of configuring the terminal to assemble data to be transmitted into data units including a preamble, a header and a payload portion, where the data units have a format according to the predefined system

specifications and where said system specifications include at least one dedicated transmission rate for the preamble, at least one dedicated transmission rate for the header, and at least one dedicated transmission rate for the payload portion. The method also includes configuring the terminal to transmit the header at a first transmission rate higher than the at least one dedicated transmission rate for the header, thereby to reduce power consumption in the terminal, where said beacon frames are transmitted in the payload portions of said data units.

In another embodiment, the invention provides a wireless terminal for a wireless communication system. The wireless terminal includes MAC layer functionalities and physical layer (PHY) functionalities, the MAC layer being configured to pass data to the physical layer, and the physical layer being configured to form data units comprising a preamble, a header and a payload portion, where the data units have a format according to predefined system specifications, which include at least one dedicated transmission rate for the preamble, at least one dedicated transmission rate for the header, and at least one dedicated transmission rate for the payload portion. The terminal also includes a first operation mode in which the terminal is configured to transmit the header at a first transmission rate higher than the at least one dedicated transmission rate for the header, thereby to reduce power consumption in the terminal, wherein said beacon frames are transmitted in the payload portions of said data units.

In further embodiments of the invention additional modifications are introduced into the MAC layer, the embodiments further shortening the transmission intervals and reducing the power consumption of the terminal.

Other features and advantages of the invention will become apparent through reference to the following detailed description and accompanying drawings.

Brief Description of the Drawings

In the following, the invention and many of its embodiments are described more closely with reference to the examples shown in FIG. **1** to **9** in the appended drawings, wherein:

FIG. **1** illustrates a typical communication system according to the invention;

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