METHODS AND DEVICES FOR EXPANDING THE RANGE OF A NETWORK

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ABSTRACT
A method for expanding a range of an ultra wide band wireless network, the method includes: (i) providing a first network and an external device, the first network includes multiple devices that receive ultra wide band wireless transmissions from each other, the external device is capable of receiving a transmission from a first device of the first network but not capable of receiving a transmission from a second device of the first network; and (ii) allowing the first device to relay transmissions between the external device and the second device. An ultra wide band device that includes: (i) a receiver, adapted to receive transmissions from members of a first network and from an external device not capable of receiving transmissions from a second device of the first network, and (ii) a transmitter, adapted to transmit information to members of the first network and to the external device; wherein the device is adapted to relay transmission from the second device of the first network to the external device.
Figure 5
providing a first network and an external device, the first network includes multiple devices that receive ultra wide band wireless transmissions from each other, the external device is capable of receiving a transmission from a first device of the first network but is not capable of receiving a transmission from a second device of the first network

informing the second device that the first device is capable of relaying information to the external device

allowing the first device to relay transmissions between the external device and the second device

receiving information from the external device and transmitting the information to the second device

FIGURE 9
providing a first network and an external device, the first network includes multiple devices that participate in a first distributed media access control scheme, whereas the external device participates in a second distributed media access control scheme and is capable of receiving a transmission from a first device of the first network but not capable of receiving a transmission from a second device of the first network.

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relaying, by the first device, transmissions between the external device and the second device.

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FIGURE 10
METHODS AND DEVICES FOR EXPANDING THE RANGE OF A NETWORK

RELATED APPLICATIONS

[0001] The present patent application is a continuation application of International Application No. PCT/US05/000021 filed Jan. 6, 2005, which claims priority benefit from U.S. Provisional Application No. 60/553,436 filed Jan. 8, 2004 and U.S. Provisional Application No. 60/535,621 filed Jan. 8, 2004, the contents of which are incorporated herein by reference.

[0002] This application is related to the following applications:


FIELD OF THE INVENTION

[0008] The invention relates to networks and especially to methods and devices for expanding the range of a network.

BACKGROUND OF THE INVENTION

[0009] Recent developments in telecommunication and semiconductor technologies facilitate the transfer of growing amounts of information over wireless networks.

[0010] Short-range ultra wide band wireless networks are being developed in order to allow wireless transmission of vast amounts of information between various devices.

[0011] Some of short-range ultra wide band wireless networks are characterized by a distributed architecture in which devices exchange information without being controlled by a central host or a base station.

[0012] FIG. 1 is a schematic illustration of two ultra wide band wireless networks (also referred to as personal access networks) 10 and 20, each including multiple devices that wirelessly communicate with each other. First network 10 includes first till third devices A-C 11-13 and the second network 20 includes forth till sixth devices D-F 24-26.

[0013] Each of the ultra wide band wireless networks uses time division multiple access (TDMA) techniques in order to allow its devices to share a single physical channel.

[0014] FIG. 2 illustrates a typical TDMA frame 30. TDMA frame 30 includes multiple time-slots, such as beacon slots 14 and media access slots. The media access slots include distributed reservation protocol (DRP) slots 36 and prioritized contention access (PCA) slots 38. PCA slots are also referred to as PCA periods. DRP slots are also referred to as DRP periods.

[0015] The beacon slots are used to synchronize devices to the TDMA frame 30. A typical beacon frame includes information that identifies the transmitting device. It also may include timing information representative of the start time of the TDMA frame 30.

[0016] The DRP slots 36 are coordinated between devices that belong to the same network and allow devices to reserve these slots in advance. During the PCA slots 38 devices that belong to the network compete for access based upon their transmission priority. It is noted that the allocation of media access time slots is dynamic and can change from one TDMA frame to another.

[0017] FIG. 3 illustrates a TDMA frame 30 of first network 10 as well as a TDMA frame 40 of second network 20. TDMA frame 40 includes multiple time-slots, such as beacon slots 44, DRP slots 46 and PCA slots 48. The TDMA frames do not overlap. It is noted that the TDMA frame includes many fixed size slots. Usually, a number of contiguous slots allocated for DRP (or PCA) ARE regarded as a DRP slot or (PCA slot).

[0018] The range of ultra wide band wireless networks is limited. This limitation can reduce the utilization of the network. There is a need to expand the range of ultra wide band wireless networks.

SUMMARY OF THE INVENTION

[0019] A method for expanding a range of an ultra wide band wireless network, the method includes: (i) providing a first network and an external device, the first network includes multiple devices that receive ultra wide band wireless transmissions from each other, the external device is capable of receiving a transmission from a first device of the first network but not capable of receiving a transmission from a second device of the first network; and (ii) allowing the first device to relay transmissions between the external device and the second device.

[0020] An ultra wide band device that includes: (i) a receiver, adapted to receive transmissions from members of a first network and from an external device not capable of receiving transmissions from a second device of the first network, and (ii) a transmitter, adapted to transmit information to members of the first network and to the external device, wherein the device is adapted to relay transmission from the second device of the first network to the external device.

[0021] A method for expanding a range of first network, the method includes: providing a first network and an external device, the first network includes multiple devices that participate in a first distributed media access control scheme, whereas the external device participates in a second
distributed media access control scheme and is capable of receiving a transmission from a first device of the first network but not capable of receiving a transmission from a second device of the first network; and relaying, by the first device, transmissions between the external device and the second device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] The present invention will be understood and appreciated more fully from the following detailed description taken in conjunction with the drawings in which:

[0023] FIG. 1 is a schematic illustration of two networks (also referred to as personal area networks), each including multiple devices that wirelessly communicate with each other;

[0024] FIG. 2 illustrates a typical TDMA frame;

[0025] FIG. 3 illustrates a TDMA frame of a first network as well as a TDMA frame of a second network;

[0026] FIGS. 4-5 illustrate a device capable of wireless transmission, and some of its components, according to an embodiment of the invention;

[0027] FIG. 6 illustrates a beacon frame, according to an embodiment of the invention.

[0028] FIGS. 7-8 illustrate various information frames, according to various embodiments of the invention; and

[0029] FIGS. 9-10 are flow charts of methods for expanding a range of a network, according to various embodiments of the invention.

DETAILED DESCRIPTION OF THE DRAWINGS

[0030] The invention provides an ultra wide band wireless medium access control method and a device capable of performing ultra wide band wireless medium access control schemes.

[0031] Conveniently, the device is a part of a ultra wideband wireless network and has a communication protocol stack that includes at least a PHY layer and a MAC layer. The MAC layer of such devices controls the access to ultra wide band wireless medium and is referred to ultra wide band wireless medium access control.


[0033] The receiver can include various components that are arranged in multiple layers. A first configuration includes a frame convergence sub-layer, a MAC layer, a PHY layer as well as MAC SAP, PHY SAP, frame convergence sub-layer SAP and a device management entity can also be utilized. Another configuration is described at FIGS. 4 and 5.

[0034] Wisair Inc. of Tel Aviv Israel manufactures a chip set that includes a Radio Frequency PHY layer chip and a Base-Band PHY layer chip. These chips can be connected in one end to a RF antenna and on the other hand can be connected to or may include a MAC layer circuitry.

[0035] FIG. 4 illustrates a device 60 that is capable of wireless transmission, according to an embodiment of the invention.

[0036] Conveniently, device 60 supports a multi-layer communication protocol stack that includes a PHY layer and a MAC layer. MAC layer hardware and/or software components form an ultra wide band wireless medium access controller, that is adapted to participate in a distributed media access control scheme that allocates at least one timeslot for a transmission of information from a first device to a group of peer devices and for a transmission of acknowledgment massages from the peer devices of the group. PHY layer hardware and/or software components form a transmission circuitry adapted to transmit the information in response to the allocation.

[0037] Device 60 includes antenna 61 that is connected to a RF chip 62. RF chip 62 is connected to a MAC/PHY layers chip 63 that includes a PHY layer block 63 and a MAC layer block 64. The MAC/PHY layers chip 63 is connected to an application entity 66 that provides it with information to be eventually transmitted (TX) and also provides the application 66 with information received (RX) by antenna 61 and processed by PHY and MAC layers blocks 68 and 69 of FIG. 4b.

[0038] Typically, the MAC layer block 64 controls the PHY layer block using a PHY status and control interface. The MAC and PHY layers exchange information (denoted TX and RX) using PHY-MAC interface 66. The RF chip 62 provides to the PHY layer block 63 received information that is conveniently down-converted to base band frequency. The RF chip 62 receives from the PHY layer block 63 information to be transmitted as well as RF control signals. The application 66 is connected to the MAC/PHY layers chip 63 by a high speed I/O interface.

[0039] FIG. 5 illustrates various hardware and software components of the MAC/PHY layers chip 63, according to an embodiment of the invention.

[0040] The Upper Layer IF block 64 of the MAC/PHY layers chip 63 includes hardware components (collectively denoted 68) and software components (collectively denoted 69). These components include interfaces to the PHY layer (MAC-PHY interface 90) and to the application (or higher layer components).

[0041] The hardware components 69 includes configuration and status registers 81, Direct Memory Access controller 82, First In First Out (FIFO) stacks 83 and frame validation and filtering components 84. DRP and PCA slots schedulers 85, ACK processors 86, and MAC-PHY internal interface 87.

[0042] The software components 68 includes a management module 72, transmit module 73, receive module 74 and hardware adaptation layer 75, DMA drivers 76, MAC layer management entity (MLME) service access point (SAP) 71, MACS API 70 and the like.

[0043] These software and hardware components are capable of performing various operations and provide various services such as: providing an interface to various layers, filtering and routing of specific application packets sent to MAC data queues or provided by these queues, performing information and/or frame processing, and the like.
The routing can be responsive to various parameters such as the destinations of the packets, the Quality of Service characteristics associated with the packets, and the like.

The processing of information along a transmission path may include: forming the MAC packet itself, including MAC header formation, aggregation of packets into a bigger PHY PDU for better efficiency, fragmentation of packets for better error rate performance, PHY rate adaptation, implementation of Acknowledgements policies, and the like.

The processing of information along a reception path may include de-aggregation and/or de-fragmentation of incoming packets, implementation of acknowledgment policies and the like.

The hardware components are capable of transferring data between MAC software queues and MAC hardware (both TX and RX), scheduling of beacon slots, scheduling of DRP and PCA access slots, validation and filtering (according to destination address) of incoming frames, encryption/decryption operations, low-level acknowledgement processing (both in the TX path and in the RX path), and the like.

Device 60 can be a simple device or even a complex device such as but not limited to a multimedia server that is adapted to transmit information frames of different types to multiple devices. It can, for example transmit streaming data, like voice, Video, Game applications, etc. data files during DRP slots, and while PCA slots transmit video over IP frames, download MP3 files, download MPEG-2 files, and stream or download MPEG-4 streams.

Device 60 (of FIG. 4b) includes a receiver, adapted to receive transmissions from members of a first network and from an external device. The external device is not capable of receiving transmissions from a second device of the first network. Device 60 further includes a transmitter, adapted to transmit information to members of the first network and to the external device; wherein the device is adapted to relay transmission from the second device of the first network to the external device.

Device 60, as illustrated in FIGS, 4 and 5, has many dual purpose components that form a part of both the receiver and the transmitter. For example, antenna 61, RF chip 62, PHY/MAC layers chip 63 are a part of the receiver and the transmitter. Nevertheless, there are some components that are not shared, such as the transmit module 73 and the receive module 74. It is noted that other configurations of device 60 can be utilized.

Conveniently, device 60 is adapted to inform the second device that device 60 is capable of relaying information to the external device. Conveniently, device 60 is adapted to receive information from the external device and transmit the information to the second device at a timing that corresponds to timing constraints of the first network.

Conveniently, the devices are adapted to perform a “peer discovery” stage. It is noted that a certain device can ask an adjacent device to relay information to another device (external device) if the certain device is aware that the external device is a potential peer device. This may involve an exchange of information between the devices. According to various embodiments of the invention this can be implemented by a requesting from devices to transmit information about their neighbors, including their identity and optionally their capabilities. A request can be answered by a response from each receiving device. The exchange can be implemented by exchanging information Elements (IEs).

A request may include a the type of requested information—DAVID, MAC address, capabilities, and the like.

It is noted that this information exchange can occur in various timings and between various devices. This can occur during device initialization, during device operation, between devices that are adjacent to the same device, between devices that belong to the same network, between devices that do not belong to the same network, or between parts of one or more networks. The exchange can be initiated by certain devices or by any device.

According to an embodiment of the invention device 60 is further adapted to allocate a first destination identification value to transmissions destined to the device 60 and to allocate a second destination identification value to transmissions destined to be relayed by the device 60 to the external device. Conveniently, during a relay operation device 60 changes destination identification information.

According to another embodiment of the invention the destination identification can also represent a last destination of the information. Conveniently, such a field is not changed during the relay operation.

According to yet another embodiment of the invention the path (or a portion of said path) that should be passed by the information frame can be represented in various manners known in the art. The path includes at least the device that originated the information frame, the last destination device and can also include one or more intermediate (relaying) devices.

Conveniently, device 60 is further adapted to request the remote device to acknowledge a reception of at least one information frame from the second device.

According to various embodiments of the invention device 60 is able to relay the information at a MAC layer or at higher communication layers.

In case of a scheme where traffic is directed to the repeater with repeater’s DEVID, the relaying device shall be able to distinguish between information frames that are intended to be relayed and between information frames that are aimed to it and are not supposed to be relayed to the external device. Conveniently, the information frame includes a destination source identification information (destination ID, or DEVID) and stream identification information (StreamID) that facilitates said distinction.

Alternatively, the traffic is marked as directed to the “final” destination, and the repeater is relaying this traffic to the intended recipient.

According to an embodiment of the invention distinct destination ID values are assigned to each device and to each relayed device. Thus, information frames aimed to device B 12 will include a certain destination ID value, while information frames that are destined to device F 26, are assigned with another destination ID value, although
they are relayed via device B12. If, for example, device B12 also relays information frames to device D24 then these information frames will include yet another destination ID value.

[0063] Conveniently, the relaying process includes replacing destination ID values. For example, if device A11 sends an information frame to device F26, via device B12, then the information frame will include a first destination ID (F via B) indicating that B12 should relay the information frame to F26. This destination ID (F via B) is replaced, by device B, by another destination ID indicating that device B is sending an information frame to device F. The other destination ID can equal the destination ID (DEVID F) used by members of the second network 20 when sending information frames to device F26.

[0064] Device B12, which is capable of relaying information frames to certain external devices shall notify other members of the first network 10 that it is capable of relaying information frames to these external devices, and shall receive a unique destination ID value for each of said certain devices.

[0065] Conveniently, each device can select certain DEVIDs from a predefined range of DEVIDs values. If a collision occurs it can be detected by transmission of said DEVID values in beacon frames, and the collision can be resolved in various well known manners.

[0066] For example, if a device receives from another device an DEVID that equals one of its DEVIDs it will notify the other device about the collision and either determine by itself how to replace the common DEVID or cooperate with the other device in order to resolve the collision. It is noted that each device that detects a DEVID collision may alter his DEVID until the collision is resolved. Typically DEVID values are selected in a random or a pseudo random manner from a predefined range of DEVIDs but this is not necessarily so. It is further noted that a certain device can be aware of a DEVID conflict if he receives transmissions from two devices that use the same DEVID.

[0067] FIG. 6 illustrates a beacon frame 400, according to an embodiment of the invention.

[0068] Beacon frame 400 is transmitted by a certain device, such as but not limited to device B12. Beacon frame 400 includes various fields such as beacon slot number field 402, DEVID of the certain device 404 (DEVID B), DEVID conflict field 406, and a list 408 of devices (represented by their DEVIDs) that are received by the certain device. Conveniently, the list 408 includes a list of beacon frames received by the device and their timings.

[0069] It is assumed that device B12 receives transmissions from devices A11 and C13 of the first network 10 and from devices F26 and D24 of the second network 20. Accordingly, list 408 includes the following DEVIDS: DEVID A, DEVID C, DEVID D, and DEVID F. List 408 may also include their beacon frame timing TI-T4. It is assumed that the times are aligned to TDMA frame 30, but this is not necessarily so.

[0070] It is noted that if the device is a relaying device than the various DEVIDs allocated for the relaying of information can appear within field 404, or within a relay indication 410. It is assumed that device B12 can relay information from device A11 and device C to devices F26 and D24 of the second network 20. Thus, relay information 410 includes four DEVIDs: F via B, B via F, B via D and D via B.

[0071] According to another embodiment these relay information fields are not used, and the need to relay a certain information frame can be dictated by the reservation of a relay slot (being either DRP or PCA slot or slots).

[0072] These relay fields are not usually required when the information frame includes a “final” destination field or information defining the transmission path.

[0073] Conveniently, the beacon frame includes additional information (not shown) indicating the capability of the certain device to accept DRP or PCA traffic during future timeslots, the intended utilization of future TDMA frames by the certain device, types of DRP reservations, rate information and other capabilities of the device.

[0074] It is noted that the various DEVIDs allocated for relay transmission, indications about DEVID conflicts, a list of received devices and the like can be transmitted in other manners. For example at least some of said information can be included within various command frames and information frames.

[0075] According to various embodiments of the invention the transmission between the external device and the relaying device can occur according to timing constraints of the first network, according to timing constraints of a second network that includes the external device or according to both timing constraints.

[0076] For example, assuming that: (i) device B12 relays information from device A11 to device F26, (ii) device B is aware of the TDMA frames of both first and second networks 10 and 20, (iii) TDMA frame 30 that is used by the members of the first network 10 does not interfere with TDMA frame 40 that is being used by the members of the second network 20. If these assumptions are satisfied then device B12 can request to transmit information frames to device F26 during various slots of TDMA frame 40, assuming that the members of the second network 20 approve the request.

[0077] Device F26 can transmit information frames to device B12 during slots of TDMA frame 40. Device B12 can exchange information frames with device A11 during slots of TDMA frame 30. It is noted that if the transmissions of the various networks overlap then device B can initiate a channel change process that will lead the members of one of the networks to use another channel, or to “re-shuffle” its DRP timing reservations. Re-shuffling does not require to perform a full DRP timing re-negotiation.

[0078] According to various embodiments of the invention the transmissions from the relaying device to the external device can be received by other members of the first network, but this is not necessarily so. For example, the relaying device can exchange information with the members of the first network using a first channel and use another channel for exchanging information with the external device. It is noted that the first and second channels have different transmission characteristics.

[0079] According to various embodiments of the invention the relaying device can transmit a single beacon frame,
that is received by both members of the first network and also by the external device, but this is not necessarily so. For example, the first device can transmit a second beacon frame for communicating with the external device. Yet for another example, device B can use a single beacon frame in order to communicate with members of the first and second networks, but this is not necessarily so and it can transmit a first beacon frame to the members of the first network and transmit a second beacon frame to the members of the second network.

0080] FIGS. 7-8 illustrate information frames 100 and 100', according to various embodiments of the invention.

0081] Information frame 100 of FIG. 7 is transmitted from device A 11 to device B 12. Information frame 100 of FIG. 8 is transmitted from device B 11 to device F 26. The information frames differ by the destination ID values that are included within.

0082] Information frame 100 includes a physical layer convergence procedure (PLCP) preamble 112, a PHY layer header 114, a MAC layer header 116, a header check sequence field (HCS) 118, header tail bits 120, header pad bits 121, payload 122, a frame check sequence field (FCS) 124, frame tail bits 126 and pad bits 128.

0083] The destination identification field 220 of information frame 100 indicates the identity of intended receivers and may indicate that the transmission is multicast or even broadcast transmission. The destination identification field 220 includes a destination ID value (denoted F_via_B) indicating that the information frame 100 is to be received by device B and then relayed to device F 26. The destination identification field 220 of information frame 100 includes a destination ID value (DEVID_F) indicating that the information frame 100 is to be sent to device F 26.

0088] As previously mentioned, field 200 can include a dedicated relay assigned information, a final destination field or another information describing the path of the information frame.

0089] The header tail bits 120 as well as the frame tail bits 126 are set to zero, thus allowing a convolutional encoder within the receiver to return to a "zero state" and improve its error probability. The header tail bits 120 (the frame tail bits 126) are followed by header pad bits 121 (frame pad bits 128) in order to align the information stream on an OFDM interleaver boundaries.

0090] FIG. 9 is a flow chart of method 200 for expanding a range of an ultra wide band wireless network.

0091] Method 200 starts by stage 210 of providing a first network and an external device, the first network includes multiple devices that receive ultra wide band wireless transmissions from each other, the external device is capable of receiving a transmission from a first device of the first network but is not capable of receiving a transmission from a second device of the first network. Referring to the example set forth in FIG. 1 it is assumed that the external device is device F 24 and that device F 24 receives transmissions from device B 12 of first network 10 but not capable of receiving transmissions from device A 11.

0092] According to an embodiment of the invention method 200 also includes a "peer identification stage. For convenience of explanation this stage was not shown.

0093] According to an embodiment of the invention stage 210 is followed by stage 215 of informing the second device that the first device is capable of relaying information to the external device. Referring to the above mentioned example, device B 12 informs device A 11, conveniently by its beacon frame, that is receives transmissions from device F 26.

0094] Stage 215 is followed by stage 220 of allowing the first device to relay transmissions between the external device and the second device. Stage 220 may include assigning different destination ID to various devices and relayed devices, enabling the relaying device to transmit and receive to various devices. Said enabling may include allocating time slots and DeliveryID for transmissions of information frames by the relaying device, transmitting one or more beacon frame by the relaying device, and the like. It is also noted that the transmission of the one or more beacon frames can occur during stage 210.

0095] Conveniently stage 220 includes allocating a first destination identification value to transmissions destined to the first device and allocating a second destination identification value to transmissions destined to be relayed by the first device to the external device.
Conveniently, stage 220 is followed by stage 230 of receiving information from the external device and transmitting the information to the second device. The transmission occurs at a timing that corresponds to timing constraints of the first network.

Stage 230 may also include receiving information from the second device and transmitting the information to the external device. The transmission occurs at a timing that corresponds to timing constraints of the external device or of a second network to which the external device belongs.

According to an embodiment of the invention, stage 230 includes changing destination identification information. Conveniently, stage 230 includes requesting the remote device to acknowledge a reception of at least one information frame from the second device.

The stage of relaying can be applied in the MAC layer or may involve other upper layers. For example, the exchange of destination ID can be done at an application layer that is above the MAC layer. Referring to the example set forth in FIG. 4a, the relaying can be done by the application 66, or by the MAC layer block 64.

FIG. 10 is a flowchart of method 300 for expanding a range of an ultra wide band wireless network.

Method 300 starts by stage 310 includes providing a first network and an external device, the first network includes multiple devices that participate in a first distributed media access control scheme, whereas the external device participates in a second distributed media access control scheme and is capable of receiving a transmission from a first device of the first network but not capable of receiving a transmission from a second device of the first network. The networks can be other than ultra wide band wireless networks.

Stage 310 can be followed by stage 320 of relaying, by the first device, transmissions between the external device and the second device.

It will be apparent to those skilled in the art that the disclosed subject matter may be modified in numerous ways and may assume many embodiments other than the preferred form specifically set out and described above. For example, the amount of access units can differ from the amount of queues, the amount of queues and the amount of transmission priorities can vary. It is noted that each of the mentioned above circuitries can be applied by hardware, software, middleware or a combination of the above.

Accordingly, the above disclosed subject matter is to be considered illustrative and not restrictive, and to the maximum extent allowed by law, it is intended by the appended claims to cover all such modifications and other embodiments, which fall within the true spirit and scope of the present invention.

The scope of the invention is to be determined by the broadest permissible interpretation of the following claims and their equivalents rather than the foregoing detailed description.

We claim:

1. A method for expanding a range of an ultra wide band wireless network, the method comprises: providing a first network and an external device, the first network comprises multiple devices that receive ultra wide band wireless transmissions from each other, the external device is capable of receiving a transmission from a first device of the first network but not capable of receiving a transmission from a second device of the first network; and allowing the first device to relay transmissions between the external device and the second device.

2. The method of claim 1 wherein the stage of allowing is preceded by a stage of informing the second device that the first device is capable of relaying information to the external device.

3. The method of claim 1 further comprising receiving information from the external device and transmitting the information to the second device at a timing that corresponds to timing constraints of the first network.

4. The method of claim 1 further comprising allocating a first destination identification value to transmissions destined to the first device and allocating a second destination identification value to transmissions destined to be relayed by the first device to the external device.

5. The method of claim 1 whereas a relaying of information involves changing destination identification information.

6. The method of claim 1 further comprising requesting the remote device to acknowledge a reception of at least one information frame from the second device.

7. The method of claim 1 further comprising relaying the information at a MAC layer.

8. The method of claim 1 further comprising relaying the information at a layer higher than the MAC layer.

9. An ultra wide band device comprising: (i) a receiver, adapted to receive transmissions from members of a first network and from an external device not capable of receiving transmissions from a second device of the first network, and (ii) a transmitter, adapted to transmit information to members of the first network and to the external device; wherein the device is adapted to relay transmission from the second device of the first network to the external device.

10. The device of claim 9 wherein the device is further adapted to inform the second device that the device is capable of relaying information to the external device.

11. The device of claim 9 further adapted to receive information from the external device and transmit the information to the second device at a timing that corresponds to timing constraints of the first network.

12. The device of claim 9 further adapted to allocate a first destination identification value to transmissions destined to the device and to allocate a second destination identification value to transmissions destined to be relayed by the device to the external device.

13. The device of claim 9 further adapted to change destination identification information.

14. The device of claim 9 further adapted to request the remote device to acknowledge a reception of at least one information frame from the second device.

15. The device of claim 9 further adapted to relay the information at a MAC layer.

16. The device of claim 9 further adapted to relay the information at a layer higher than the MAC layer.

17. A method for expanding a range of first network, the method comprises: providing a first network and an external device, the first network comprises multiple devices that participate in a first distributed media access control scheme, whereas the external device participates in a second distrib-
uted media access control scheme and is capable of receiving a transmission from a first device of the first network but not capable of receiving a transmission from a second device of the first network; and relaying, by the first device, transmissions between the external device and the second device.

18. The method of claim 17 wherein the stage of relaying is preceded by a stage of informing the second device that the first device is capable of relaying information to the external device.

19. The method of claim 17 further comprising receiving information from the external device and transmitting the information to the second device over an ultra wide band wireless medium.

20. The method of claim 17 further comprising allocating a first destination identification value to transmissions destined to the first device and allocating a second destination identification value to transmissions destined to be relayed by the first device to the external device.

21. The method of claim 17 wherein a relaying of information involves changing destination identification information.

22. The method of claim 17 further comprising requesting the remote device to acknowledge a reception of at least one information frame from the second device.

23. The method of claim 17 further comprising relaying the information at a MAC layer.

24. The method of claim 17 further comprising relaying the information at a layer higher than the MAC layer.

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