[0001] # WIRELESS COMMUNICATION METHOD AND SYSTEM FOR CONVEYING MEDIA INDEPENDENT HANDOVER CAPABILITY INFORMATION

[0002] ## FIELD OF INVENTION

[0003] The present invention is related to wireless communication systems. More particularly, the present invention is related to a method and system for conveying media independent handover (MIH) capability information.

[0004] ## BACKGROUND

[0005] Currently, many different types of wireless networks are deployed, which provide specific services that each wireless network is intended for. For example, wireless local area networks (WLANs), such as IEEE 802.xx based networks, provide high data rate services in a limited coverage area while cellular networks, such as universal mobile telecommunication system (UMTS) networks, provide relatively low to medium data rate services in a very large coverage area supporting high speed mobility.

[0006] IEEE 802.21 MIH has been proposed for a seamless handover among these heterogeneous networks enabling continuous reception of services while roaming around these heterogeneous networks. However, MIH may not be supported by all networks and the supported MIH mode may vary from network to network. Therefore, it would be desirable to provide wireless transmit/receive unit (WTRU) MIH capability information, (e.g., including whether a wireless network supports MIH and, if it is supported, what mode of MIH is supported).

[0007] ## SUMMARY

[0008] The present invention is related to a method and system for conveying MIH capability information. A wireless communication system includes a plurality of wireless networks deployed under different wireless communication protocols. A multi-mode WTRU may perform a handover from one wireless network to another for continuous reception of services. The wireless network sends a message to the WTRU which indicates whether the

wireless network supports MIH services and a supported MIH mode. The WTRU receives the message and makes a handover decision based on the message.

[0009] BRIEF DESCRIPTION OF THE DRAWINGS

[0010] A more detailed understanding of the invention may be had from the following description of a preferred embodiment, given by way of example and to be understood in conjunction with the accompanying drawings wherein:

[0011] Figure 1 shows an exemplary wireless communication system configured in accordance with the present invention;

[0012] Figure 2 shows a medium access control (MAC) protocol data unit (PDU) with logical link control (LLC) encapsulation for conveying MIH services in accordance with the present invention;

[0013] Figure 3 shows an IP frame for conveying MIH services in accordance with the present invention;

[0014] Figure 4 shows an exemplary bit map for conveying MIH capability information using a full octet in accordance with the present invention;

[0015] Figure 5 shows an exemplary bit map for conveying MIH capability information in a capability information field of a beacon frame in accordance with the present invention;

[0016] Figure 6 shows an exemplary bit map for conveying MIH capability information in accordance with the present invention; and

[0017] Figure 7 is a block diagram of a WTRU in accordance with the present invention.

[0018] DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0019] Hereafter, the terminology "WTRU" includes but is not limited to a user equipment, a mobile station, a fixed or mobile subscriber unit, a pager, or any other type of device capable of operating in a wireless environment. When referred to hereafter, the terminology "base station" and access point (AP) includes but is not limited to a Node-B, a site controller or any other type of interfacing device in a wireless environment.

[0020] The features of the present invention may be incorporated into an integrated circuit (IC) or be configured in a circuit comprising a multitude of interconnecting components.

[0021] Figure 1 shows an exemplary wireless communication system 100 configured in accordance with the present invention. The system 100 includes a plurality of wireless networks 110 and 111a-111n that are concurrently deployed under different wireless communication standards and provide specific services in specific coverage areas which may or may not overlap each other. For example, the system 100 may include a cellular network 110 and a plurality of wireless local area networks 111a-111n. The cellular network 110 may be third generation partnership (3GPP) networks or 3GPP2 networks, and the wireless local area networks 111a-111n may be IEEE 802 based networks, (such as 802.11 baseline, 802.11a, 802.11b, 802.11g, 802.11j, 802.11n, 802.11e, 802.11s, 802.11k, 802.11v, 802.15, 802.16 and 802.21 networks), Bluetooth™ networks, HIPERLAN/2, or any other type of networks. The cellular network 110 includes a plurality of cells 112, each of which is covered by a base station 114. The WLANs 111a-111n are served by APs 122a-122n, respectively.

[0022] As a WTRU 130 roams around an area where a plurality of heterogeneous networks 110 and 111a-111n, (e.g., cellular networks and WLANs), are concurrently deployed, the WTRU 130 needs to determine, quickly, the most suitable network based on requirements of the service requested by the user. For example, a video application may require a high bandwidth channel, while a voice application may be sufficient with a low bandwidth channel. The speed at which the WTRU 130 can find a suitable network depends on its ability to retrieve network information from available networks.

[0023] In accordance with the present invention, the networks 110 and 111a-111n convey MIH capability information to the WTRU 130 preferably via a broadcast channel. The MIH capability information may be transmitted over either a wired or wireless medium. The MIH capability information indicates not only whether the network support MIH services but also the supported MIH mode. MIH services include information service, event service and command

service for conveying handover related information, events and command. The supported MIH mode indicates MIH functionality supported by the network. With these two pieces of information, the WTRU 130 can make a more intelligent decision with regards to whether or not the particular network should be considered for handover.

[0024] For example, the MIH services may be provided either over layer 2 (L2) procedures and messages or over layer 3 (L3) procedures and messages, (such as Internet protocol (IP)). Figure 2 shows a MAC PDU 200 with LLC encapsulation for conveying MIH services in accordance with the present invention. The MAC PDU 200 includes MAC headers 202, an LLC header 204, an RFC 1042 encapsulation 206, an Either Type field 208, a frame body 210 and a frame check sequence (FCS) field 212. The LLC header 204 includes a sub-network access protocol (SNAP) destination service access point (DSAP) field 214, an SNAP source service access point (SSAP) field 216 and a control field 218. The RFC 1042 encapsulation 206 and the Either Type field 208 are used for carrying IP datagram over IEEE 802 networks. The MIH protocol used for the provision of MIH services can be carried over a L2 transport using an LLC encapsulation by defining a new Ether Type 208 that uniquely identifies the MIH protocol. An MIH header 220 and an MIH payload 222 are included in the frame body 210.

[0025] Alternatively, a higher layer protocol such as IP may be used to achieve similar results. Figure 3 shows an IP frame 300 for conveying MIH services in accordance with the present invention. MIH services are transported over an IP frame by defining a new Protocol ID 302 and encapsulating the MIH protocol within a data field 304 of the IP frame 300.

[0026] The present invention provides the WTRU with a means to determine which transport method is supported in a particular network. This information is provided through the MIH mode parameter.

[0027] Since there is not much available space on current broadcast channels, minimum number of bits, preferably two bits, should be used to convey MIH capability information. A simple bit map provides the WTRU 130 with a

quick indication of the capabilities of the networks 110 and 111a-111n with regards to MIH functionality. If more space is available, more information may be provided using more bits, (e.g., a full octet), as shown in Figure 4.

[0028] Exemplary bit maps using two bits, B0 and B1, are explained hereinafter. A combination of two bits indicates whether the network 110 and 111a-111n supports MIH services and the supported MIH mode. For example, if B1 = '0' and B0 = '0', this indicates that the network 110 and 111a-111n does not provide any MIH services. However, in such case, the WTRU 130 may still be able to obtain MIH services over and an IP connection. If B1 = '0' and B0 = '1', this indicates that the network 110 and 111a-111n provides some MIH services, and information services may be accessed over L2 procedures over an Ethernet connection, (such as shown in Figure 2), without having to rely on IP connectivity. If B1 = '1' and B0 = '1', this indicates that the network 110 and 111a-111n provides MIH services, and information service is accessible over both L2 procedures and L3 procedures over an IP connection, (such as shown in Figure 3). If B1 = '1' and B0 = '0', this indicates that the network 110 and 111a-111n provides some MIH services, (i.e., command and event services), but information service may only be accessed over L3 procedures (i.e., via an IP connection).

[0029] Figure 5 shows an exemplary bit map for conveying MIH capability information in a capability information field 500 of a beacon frame in an IEEE 802.11 network in accordance with the present invention. In this example, an MIH support bit 502 and an MIH mode bit 504 are added in the capability field 500 of the beacon frame. B0 and B1 of the foregoing example are replaced with the MIH support bit 502 and the MIH mode bit 504, respectively.

[0030] Figure 6 shows an exemplary bit map for conveying MIH capability information in an IEEE 802.16 network in accordance with the present invention. IEEE 802.16 defines a set of medium access control (MAC) management messages including a subscriber station (SS) basic capability request (SBC-REQ) message and an SS basic capability response (SBC-RSP) message. The SBC-REQ and SBC-RSP messages are exchanged between a WTRU and a network during initialization. A WTRU generates the SBC-REQ

message and sends it to the network. The WTRU includes supported physical parameters and bandwidth allocation in the SBC-REQ message. The network sends the SBC-RSP message in response to the SBC-REQ message. The network responds to the subset of the capabilities present in the SBC-REQ message indicating whether they may be used.

[0031] In accordance with the present invention, a new MAC management message type for SBC-REQ and SBC-RSP messages is defined for MIH support. Figure 6 shows an exemplary IEEE 802.16 bit map for this purpose. Bit #0 is reserved. Bit #1 set to '0' indicates no MIH is supported by the network and bit #1 set to '1' indicates MIH services are supported by the network. Bit #2 set to '0' indicates MIH information is accessible over Ethernet transport and bit #2 set to '1' indicates MIH information is accessible over IP transport. Other bits may be used to convey other capability information.

[0032] Referring again to Figure 4, an exemplary bit map for conveying MIH capability information using a full octet in accordance with the present invention is shown. A first bit, B0, indicates whether the network supports MIH services, (i.e., if B0 = '1', this indicates that the network supports MIH services, and if B0 = '0', this indicates that the network does not support MIH services). If the network supports MIH services, (i.e., B0 = '1'), then additional bits, (in the example of Figure 4, seven (7) bits, B1-B7), provide further information with regards to the capability of the network to deliver these services. If B1 = '0', this indicates that MIH services are available without the need to contact a separate network entity over IP. If B1 = '1', this indicates that the network does not support MIH services, (particularly, information services), over L2 procedures, and therefore the WTRU is required to contact an information server over an L3 transport. If B2 is set, (i.e., B2 = '1'), this indicates that the network provides cellular integration support and if B3 is set, (i.e., B3 = '1'), this indicates that the network provides IEEE 802.16 support. Other capability information may be provided in a similar manner.

[0033] It should be noted that the bit maps shown in Figures 4-6 are provided as an example, not as a limitation and any variation is possible.

[0034] Figure 7 is a block diagram of a WTRU 700 in accordance with the present invention. The WTRU 700 includes a receiver 702 and a handover controller 704. The receiver 702 is configured to receive a message transmitted from a network. The handover controller 704 is configured to extract MIH information from the message. The MIH information indicates whether the wireless network supports MIH services and a supported MIH mode as described hereinbefore. The handover controller 704 then performs a handover based on the MIH information. The WTRU 700 may further comprise a transmitter 706 configured to send a request to the network to request the message, whereby the message may be sent in response to the request.

[0035] Embodiments of the present invention.

[0036] 1. A method of providing MIH information to a multi-mode WTRU in a wireless communication system including a plurality of wireless networks deployed under different wireless communication protocols, wherein a wireless network sends a message including an indication indicating whether the wireless network supports MIH services and information about the supported MIH mode to the WTRU, whereby the WTRU makes a network handover decision based on the message.

[0037] 2. The method of embodiment 1 wherein the message is broadcast.

[0038] 3. The method of embodiment 2 wherein the message is included in a beacon frame.

[0039] 4. The method of embodiment 3 wherein the message is included in a capability information field of the beacon frame.

[0040] 5. The method as in any of embodiments 1-4, wherein the message indicates at least one of whether information service is delivered over Ethernet, whether information service is delivered over an IP network, cellular integration support and IEEE 802.16 support.

[0041] 6 The method as in any of embodiments of 1-5, wherein the message is sent in response to a request from the WTRU.

[0042] 7. The method as in any of embodiments 1-6, wherein the

message is an IEEE 802.16 MAC management message.

[0043] 8. The method of embodiment 7 wherein the message is an SBS-RSP message which is sent in response to an SBS-REQ message.

[0044] 9. A wireless communication system configured to facilitating MIH by providing MIH capability information, comprising a multi-mode WTRU including at least two wireless interfaces for supporting at least two wireless communication protocols and a plurality of concurrently deployed wireless networks under different wireless communication standards and the wireless networks are configured to send a message including an MIH support indication and a supported MIH mode, whereby the WTRU makes a network handover decision based on the message.

[0045] 10. The system of embodiment 9 wherein the wireless network broadcasts the message.

[0046] 11. The system of embodiment 10 wherein the wireless network includes the message in a beacon frame.

[0047] 12. The system of embodiment 11 wherein the wireless network includes the message in a capability information field of the beacon frame.

[0048] 13. The system as in any of embodiments 9-12, wherein the message indicates at least one of whether information service is delivered over Ethernet, whether information service is delivered over an IP network, cellular integration support and IEEE 802.16 support.

[0049] 14 The system as in any of embodiments 9-13, wherein the wireless network sends the message in response to a request from the WTRU.

[0050] 15. The system as in any of embodiments 9-14, wherein the message is an IEEE 802.16 MAC management message.

[0051] 16. The system of embodiment 15 wherein the message is an SBS-RSP message which is sent in response to an SBS-REQ message.

[0052] 17. A wireless communication system configured to facilitating MIH by providing MIH capability information comprising: a multi-mode WTRU including at least two wireless interfaces for supporting at least two wireless communication protocols and means for making a handover decision; and a

plurality of concurrently deployed wireless networks under different wireless communication standards, the wireless networks including means for sending a message including an MIH support indication and a supported MIH mode to the WTRU, whereby the WTRU makes a network handover decision based on the message.

[0053] 18. The system of embodiment 17 wherein the wireless network is configured to broadcast the message.

[0054] 19. The system of embodiment 18 wherein the wireless network includes the message in a beacon frame.

[0055] 20. The system of embodiment 19 wherein the wireless network includes the message in a capability information field of the beacon frame.

[0056] 21. The system as in any of embodiments 17-20, wherein the message indicates at least one of whether information service is delivered over Ethernet, whether information service is delivered over an IP network, cellular integration support and IEEE 802.16 support.

[0057] 22. The system as in any of embodiments 17-21, wherein the WTRU includes means for sending a request to the wireless network, whereby the wireless network sends the message in response to the request from the WTRU.

[0058] 23. The system as in any of embodiments 17-22, wherein one of the interfaces of the WTRU is IEEE 802.16 interface and one of the wireless network is IEEE 802.16 network and the message is an IEEE 802.16 MAC management message.

[0059] 24. The system of embodiment 23 wherein the message is a SBS-RSP message which is sent in response to an SBS-REQ message.

[0060] 25. A WTRU configured to perform a handover from one wireless network to another for continuous reception of services in a wireless communication system including a plurality of wireless networks deployed under different wireless communication protocols, the WTRU comprising a receiver configured to receive a message from a network; and a handover controller configured to extract MIH information from the message, which indicates

whether the wireless network supports MIH services and a supported MIH mode and perform a handover based on the MIH information.

[0061] 26. The WTRU of embodiment 25 wherein the message is broadcast.

[0062] 27. The WTRU of embodiment 26 wherein the message is included in a beacon frame.

[0063] 28. The WTRU of embodiment 27 wherein the message is included in a capability information field of the beacon frame.

[0064] 29. The WTRU of embodiment 25 wherein the message indicates at least one of whether information service is delivered over Ethernet, whether information service is delivered over an IP network, cellular integration support and IEEE 802.16 support.

[0065] 30 The WTRU of embodiment 25 further comprising a transmitter configured to send a request to the network, whereby the message is sent in response to the request.

[0066] 31. The WTRU of embodiment 30 wherein the message is an IEEE 802.16 medium access control (MAC) management message.

[0067] 32. The WTRU of embodiment 31 wherein the message is a subscriber station (SS) basic capability response (SBS-RSP) message and the request is an SS basic capability request (SBS-REQ) message.

[0068] Although the features and elements of the present invention are described in the preferred embodiments in particular combinations, each feature or element can be used alone without the other features and elements of the preferred embodiments or in various combinations with or without other features and elements of the present invention.

* * *

CLAIMS

What is claimed is:

1. In a wireless communication system including a plurality of wireless networks deployed under different wireless communication protocols, wherein a multi-mode wireless transmit/receive unit (WTRU) may perform a handover from one wireless network to another for continuous reception of services, a method of providing media independent handover (MIH) information to the WTRU, the method comprising:

a wireless network sending a message to the WTRU, the message indicating whether the wireless network supports MIH services and a supported MIH mode; and

the WTRU making a network handover decision based on the message.

2. The method of claim 1 wherein the message is broadcast.

3. The method of claim 2 wherein the message is included in a beacon frame.

4. The method of claim 3 wherein the message is included in a capability information field of the beacon frame.

5. The method of claim 1 wherein the message indicates at least one of whether information service is delivered over Ethernet, whether information service is delivered over an Internet protocol (IP) network, cellular integration support and IEEE 802.16 support.

6 The method of claim 1 wherein the message is sent in response to a request from the WTRU.

7. The method of claim 6 wherein the message is an IEEE 802.16 medium access control (MAC) management message.

8. The method of claim 7 wherein the message is a subscriber station (SS) basic capability response (SBS-RSP) message which is sent in response to an SS basic capability request (SBS-REQ) message.

9. A wireless communication system configured to facilitating media independent handover (MIH) by providing MIH capability information, the system comprising:

a multi-mode wireless transmit/receive unit (WTRU) including at least two wireless communication interfaces for supporting at least two wireless communication protocols; and

a plurality of concurrently deployed wireless networks, each wireless network being deployed under a different wireless communication standards and configured to send a message to the WTRU, the message including an MIH support indication and a supported MIH mode, whereby the WTRU makes a network handover decision for continuous reception of services based on the message.

10. The system of claim 9 wherein the wireless network broadcasts the message.

11. The system of claim 10 wherein the wireless network includes the message in a beacon frame.

12. The system of claim 11 wherein the wireless network includes the message in a capability information field of the beacon frame.

13. The system of claim 9 wherein the message indicates at least one of whether information service is delivered over Ethernet, whether information service is delivered over an Internet protocol (IP) network, cellular integration support and IEEE 802.16 support.

14 The system of claim 9 wherein the wireless network sends the message in response to a request from the WTRU.

15. The system of claim 14 wherein the message is an IEEE 802.16 medium access control (MAC) management message.

16. The system of claim 15 wherein the message is a subscriber station (SS) basic capability response (SBS-RSP) message which is sent in response to an SS basic capability request (SBS-REQ) message.

17. A wireless communication system configured to facilitating media independent handover (MIH) by providing MIH capability information, the system comprising:

a multi-mode wireless transmit/receive unit (WTRU) including:

at least two wireless interfaces for supporting at least two wireless communication protocols; and

means for making a handover decision; and

a plurality of concurrently deployed wireless networks, each wireless network being deployed under a different wireless communication standards and includes means for sending a message including an MIH support indication and a supported MIH mode to the WTRU, whereby the WTRU makes a network handover decision for continuous reception of services based on the message.

18. The system of claim 17 wherein the wireless network is configured to broadcast the message.

19. The system of claim 18 wherein the wireless network includes the message in a beacon frame.

20. The system of claim 19 wherein the wireless network includes the message in a capability information field of the beacon frame.

21. The system of claim 17 wherein the message indicates at least one of whether information service is delivered over Ethernet, whether information service is delivered over an Internet protocol (IP) network, cellular integration support and IEEE 802.16 support.

22. The system of claim 17 wherein the WTRU includes means for sending a request to the wireless network, whereby the wireless network sends the message in response to the request from the WTRU.

23. The system of claim 22 wherein one of the interfaces of the WTRU is IEEE 802.16 interface and one of the wireless network is IEEE 802.16 network and the message is an IEEE 802.16 medium access control (MAC) management message.

24. The system of claim 23 wherein the message is a subscriber station (SS) basic capability response (SBS-RSP) message which is sent in response to an SS basic capability request (SBS-REQ) message.

25. In a wireless communication system including a plurality of wireless networks deployed under different wireless communication protocols, a wireless transmit/receive unit (WTRU) configured to perform a handover from one wireless network to another for continuous reception of services, the WTRU comprising:

a receiver configured to receive a message from a network; and

a handover controller configured to extract media independent handover (MIH) information from the message, the MIH information indicating whether the wireless

network supports MIH services and a supported MIH mode and perform a handover based on the MIH information.

26. The WTRU of claim 25 wherein the message is broadcast.

27. The WTRU of claim 26 wherein the message is included in a beacon frame.

28. The WTRU of claim 27 wherein the message is included in a capability information field of the beacon frame.

29. The WTRU of claim 25 wherein the message indicates at least one of whether information service is delivered over Ethernet, whether information service is delivered over an Internet protocol (IP) network, cellular integration support and IEEE 802.16 support.

30 The WTRU of claim 25 further comprising a transmitter configured to send a request to the network, whereby the message is sent in response to the request.

31. The WTRU of claim 30 wherein the message is an IEEE 802.16 medium access control (MAC) management message.

32. The WTRU of claim 31 wherein the message is a subscriber station (SS) basic capability response (SBS-RSP) message and the request is an SS basic capability request (SBS-REQ) message.