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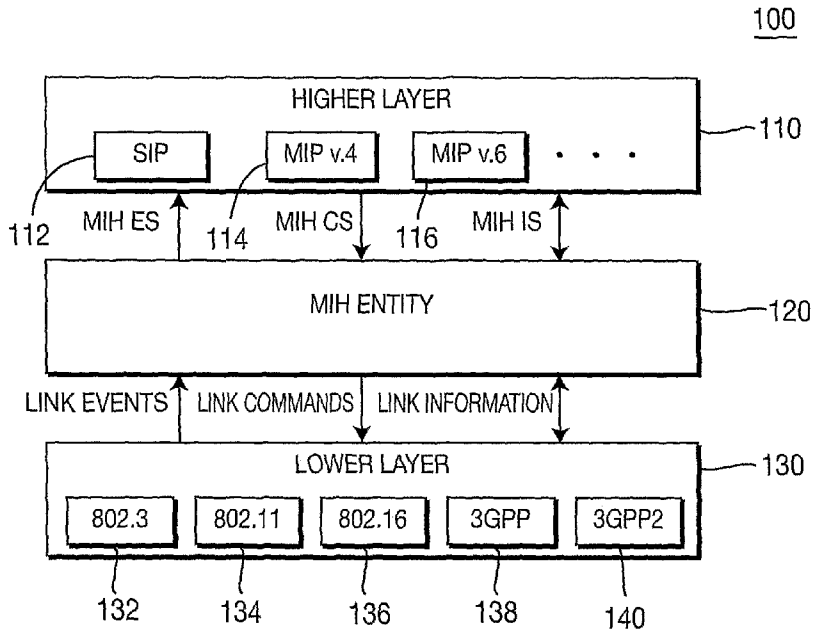
(54) **Title:** METHOD AND SYSTEM FOR MEDIA INDEPENDENT HANDOVER USING OPERATION, ADMINISTRATION AND MAINTENANCE PROTOCOL



(57) **Abstract:** A method and system for media independent handover (MIH) using an Ethernet operation, administration and maintenance (OAM) protocol are disclosed. Link connectivity between a user equipment (UE) and an MIH point of service (PoS) is monitored by using an OAM protocol. An OAM trigger indicating a link status is mapped to an MIH event and the MIH event is reported for potential handover. The OAM protocol may be IEEE 802.3ah or 802.1ag.

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[0001] # METHOD AND SYSTEM FOR MEDIA INDEPENDENT HANDOVER USING OPERATION, ADMINISTRATION AND MAINTENANCE PROTOCOL

[0002] ## FIELD OF INVENTION

[0003] The present invention is related to communication systems. More particularly, the present invention is related to a method and system for media independent handover (MIH) using an Ethernet operation, administration and maintenance (OAM) protocol.

[0004] ## BACKGROUND

[0005] IEEE 802.21 provides architecture to enable a seamless handover process based on measurements and triggers supplied from link layers. IEEE 802.21 defines media independent event service (ES), command service (CS) and information service (IS). IEEE 802.21 also defines medium access control (MAC) layer service access points (SAPs) and associated primitives for each specific access technology.

[0006] IEEE 802.21 MIH event and information service (EIS) requires MAC or physical layer-based event notification for link status updates between a user equipment (UE) and an MIH point of service (PoS). The MIH EIS events include link up, link down, link parameters change, link going down, service data unit (SDU) transmission status, link event rollback, pre trigger (L2 handoff imminent), and the like. Currently, link layer extensions required to support MIH EIS are under consideration for various technologies.

[0007] For Ethernet networks, link monitoring using continuity messages is necessitated where physical layer signaling is inadequate to detect a connectivity status between two communication peers. IEEE 802.3ah Ethernet first mile (EFM) provides an extension to the 802.3 physical layer signaling to facilitate a connectivity status determination. IEEE 802.3ah provides link monitoring, fault signaling and remote loopback. Link monitoring serves for detecting and indicating link faults under a variety of conditions so entities can

detect failed and degraded connections. Fault signaling provides mechanisms for one entity to signal another that it has detected an error. Remote loopback, which is often used for troubleshooting, allows one entity to put another entity into a state whereby all inbound traffic is immediately reflected back onto the link.

[0008] IEEE 802.1ag, (also known as connectivity fault management (CFM)), specifies protocols, procedures and managed objects to support transport fault management for end to end Ethernet networks at the customer, operator and service provider levels. These allow discovery and verification of the path through bridges and local area networks (LANs) and detection and isolation of connectivity fault to a specific bridge or LAN.

[0009] CFM mechanisms for fault detection include continuity check, traceroute, loopback (ping), alarm indication, and the like, at different OAM domains, (e.g., operator domain, provider domain and customer domain). Each maintenance domain carries CFM messages using destination address and EtherType. CFM messages are sourced or received at maintenance end points (MEPs) after traversing zero or more maintenance intermediate points (MIPs). The CFM messages pass transparently through 802.1Q or 802.1ad bridges. Multiple instances of CFM can operate at multiple levels on the same bridge port simultaneously.

[0010] Although conventional arts provide a mechanism to detect link problems and provide this information to the link end-points, there is currently no means to make use of this information for the purpose of triggering handover operation towards an alternative link.

[0011] SUMMARY

[0012] The present invention is related to a method and system for MIH using an Ethernet OAM protocol. Link connectivity between a UE and an MIH PoS is monitored by using an OAM protocol. An OAM trigger indicating a link status is mapped to an MIH event and the MIH event is reported for potential handover. The OAM protocol may be IEEE 802.3ah or 802.1ag. The access

networks may be 802.1D-bridged network or 802.1Q-bridged network.

[0013] BRIEF DESCRIPTION OF THE DRAWINGS

[0014] Figure 1 shows functional entities of a UE in accordance with the present invention.

[0015] Figure 2 shows a UE and an MIH PoS monitoring a link status using 802.3ah OAM messages in accordance with the present invention.

[0016] Figure 3 shows an exemplary system for supporting MIH using 802.3ah OAM messages in accordance with a first embodiment of the present invention.

[0017] Figure 4 shows a UE and an MIH PoS connected through an 802.1D-bridged network and monitoring a link status using 802.1ag OAM messages in accordance with the present invention.

[0018] Figure 5 shows a UE and an MIH PoS connected through an 802.1Q bridged network and monitoring a link status using 802.1ag OAM messages in accordance with the present invention.

[0019] Figure 6 shows an exemplary system for supporting MIH using 802.1ag OAM messages in accordance with a second embodiment of the present invention.

[0020] DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0021] Hereafter, the terminology "UE" includes but is not limited to a wireless and/or wired transmit/receive unit (TRU), a mobile station (STA), a fixed or mobile subscriber unit, a pager, or any other type of device capable of operating in a wireless and/or wired environment.

[0022] 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.

[0023] In accordance with the present invention, MIH endpoints, (i.e., an UE and an MIH PoS), are made as OAM peer entities and a link status between the UE and the MIH PoS is monitored by using an OAM protocol, (such as

802.3ag or 802.1ag). An OAM trigger indicating a detected link status is mapped to an MIH event. The MIH event is reported to higher layers for potential handover. The MIH PoS is a network entity providing MIH services. The MIH PoS may reside in any place in the network. For example, the MIH PoS may reside in a point of attachment (PoA) or in a core network. In accordance with the present invention, the current link status information is made available to an 802.21 PoS with MIH capabilities, and the PoS may use it to trigger a handover towards an alternate link whenever a problem with the current link is reported. The present invention provides a mechanism to generically use the 802.1 link detection mechanism for handover decision over 802.3 and 802.11 networks.

[0024] Figure 1 shows functional entities of the UE 100 in accordance with the present invention. The UE 100 includes a higher layer 110, an MIH entity 120 and a lower layer 130. The higher layer 110 includes a session initiation protocol (SIP) entity 112, a mobile Internet protocol version 4 (MIP v.4) entity 114, a mobile Internet protocol version 6 (MIP v.6) entity 116, and the like. The lower layer 130, (i.e., layer 2 and layer 1), includes an IEEE 802.3 entity 132, an IEEE 802.11 entity 134, an IEEE 802.16 entity 136, a third generation partnership project (3GPP) entity 138, a 3GPP2 entity 140, and the like. The MIH entity 120 receives link events and link information from the lower layer 130. Based on the reported link events and information from the lower layer 130, the MIH entity 120 generates MIH events and information and sends them to the higher layer 110. The MIH entity 120 receives MIH commands and information from the higher layer 110. Based on the MIH commands and information received from the higher layer 110, the MIH entity 120 generates link commands and link information and sends them to the lower layer 130.

[0025] Figure 2 shows a UE 202 and an MIH PoS 208 monitoring a link status using 802.3ah OAM messages in accordance with the present invention. A connection between the UE 202 and the MIH PoS 208 is established via a network 210 including one or more hubs (or repeaters) 204, 206. The first hub (or repeater) 204 is a PoA. When the UE 202 and the MIH PoS 208 are connected through a hub (or repeater) 204, 206, the 802.3 physical layer signaling at the

layer 1 interface of the UE 202 is unable to detect the link event change between the hub (or repeater) 204, 206 and the MIH PoS 208. Therefore, the end to end semantics required for a handover decision are lost as loss of connectivity between the hubs (or repeaters) 204, 206 is not visible to either the UE 202 or the MIH PoS 208. It should be noted that the loss of connectivity beyond the MIH PoS 208 is beyond the scope of what can be accomplished by IEEE 802.21.

[0026] In accordance with a first embodiment of the present invention, the MIH endpoints, (i.e., the UE 202 and the MIH PoS 208), are made as OAM peer entities and the link status between the UE 202 and the MIH PoS 208 are monitored by using an IEEE 802.3ah protocol. Both the UE 202 and the MIH PoS 208 include an MIH entity. The PoA 204 may include an MIH entity. In such case, the PoA 204 works as an MIH capable PoA. The MIH entities of the UE 202 and the MIH PoS 208, (optionally, an MIH entity of the MIH PoA 204), use this link status information to generate an 802.21 MIH event notification about the link status.

[0027] When a link status is detected using an 802.3ah protocol, an OAM trigger is forwarded to the MIH entity of the UE 202 (or the MIH PoS 208 and the MIH PoA 204). The OAM triggers are then mapped to MIH events by the MIH entity of the UE 202 (or the MIH PoS 208 and the MIH PoA 204) and reported to higher layers for triggering a handover.

[0028] Table 1 shows mapping of 802.3ah triggers to 802.21 events. Some of the currently defined MIH events can be associated with 802.3ah triggers. The 802.3ah framework allows extension of this subset by a vendor using custom type-length-value (TLV) specification. An 802.3ah link up event indicating that the physical layer has determined that the link is up and the OAM remote entity is up is mapped to an 802.21 link up event. An 802.3ah link fault event indicating that the physical layer has determined a fault has occurred in the receive direction of the local data terminal equipment (DTE) is mapped to an 802.21 link down event. An 802.3ah dying gasp event indicting that an unrecoverable local failure condition has occurred is mapped to an 802.21 link going down event.

MIH Event	802.3ah Triggers	
	Event	Description
Link Up	Link Up	The PHY has determined that the link is up AND the OAM Remote Entity is up.
Link Down	Link fault	The PHY has determined a fault has occurred in the receive direction of the local DTE
Link Going Down	Dying Gasp	An unrecoverable local failure condition has occurred.

Table 1

[0029] Figure 3 shows an exemplary system 300 for supporting MIH services using 802.3ah OAM in accordance with the present invention. The system 300 includes a UE 302, a wireless local area network (WLAN) 310, an 802.3 network 320 and an MIH PoS 330. The 802.3 network 320 includes a plurality of inter-connected hubs (or repeaters) 322, 324. The UE 302 is MIH capable and supports both the WLAN access technology and 802.3 access technology. The UE 302 and the MIH PoS 330 are two OAM peer entities and the link status between the UE 302 and the MIH PoS 330 are monitored by using an IEEE 802.3ah protocol. Upon detection of one of the 802.3ah triggers, an MIH entity of the UE 302 (or the MIH PoS 330) maps the 802.3ah trigger to an 802.21 event. Therefore, MIH communication between the UE 302 and the MIH PoS 308 is established through one of the WLAN 310 and the 802.3 network 320 as shown in Figure 3. Based on the reported MIH event, a handover may be triggered between the WLAN 310 and the 802.3 network 320.

[0030] In accordance with a second embodiment of the present invention, the link status between a UE and an MIH PoS is monitored by using an IEEE 802.1ag protocol. If the UE is connected to the MIH PoS through an 802.1D or 802.1Q-bridged network as shown in Figures 4 and 5, an 802.3 layer 1 event notification or 802.3ah OAM messages are insufficient to detect loss of connectivity between the UE and the MIH PoS.

[0031] Figure 4 shows an UE 402 and an MIH PoS 408 connected through

an 802.1D-bridged network 410 and monitoring a link status using 802.1ag OAM messages in accordance with the present invention. The 802.1D-bridged network 410 includes hubs 404 and bridges/switches 405, 406. The connection between the UE 402 to the MIH PoS 408 is established via one or more 802.1D bridges or switches. When the UE 402 and the MIH PoS 408 are connected through an 802.1D-bridged network 410, an 802.3 level physical layer link status notification is insufficient to detect a link connectivity to the MIH PoS 408 and IEEE 802.3ah OAM messages do not traverse 802.1D bridges/switches 405, 406.

[0032] Figure 5 shows an UE 502 and an MIH PoS 508 connected through an 802.1Q bridged network and monitoring a link status using 802.1ag OAM messages in accordance with the present invention. The UE 502 is connected to a hub, (i.e., PoA), 504. The connection between the PoA 504 to the MIH PoS 508 is established via one or more 802.1Q bridges or switches 512, 522. When the bridges or switches 512, 522 are 802.1Q bridges or switches, the reachability to the MIH PoS 508 may be through different links for different virtual local area networks (VLANs) 510, 520, either due to static configuration or through configuration of spanning tree running on each bridge. In such case, the MIH connectivity between the UE 502 and the MIH PoS 508 needs to be established and monitored on a per VLAN identity (ID) basis.

[0033] In accordance with the second embodiment of the present invention, the 802.1ag protocol for customer level OAM is used to detect the end to end link status by mapping the 802.1ag management information base (MIB) objects to the 802.21 events. Table 2 shows a mapping of 802.1ag MIB objects to the 802.21 events.

[0034] An 802.1ag MIB object indicating that a connectivity is detected or has been restored is mapped to an 802.21 link up event. An 802.1ag MIB object indicating that a management end point (MEP) has lost contact with one or more MEPs is mapped to an 802.21 link down event. A new 802.1ag MIB object is defined to indicate the number of connectivity check frames that can be lost before indicating a fault has occurred to map 802.21 link going down event to 802.1ag dying gasp.

[0035] A link going down event is used whenever there is a possibility that a link might fail, (e.g., due to poor radio conditions). Where the current link is supported via 802.3, the link going down status may be flagged when it is determined that the connection would likely be down within a short period of time after looking at the amount of frames that have been lost. For example, if a threshold is set to ten (10) frame losses before the link is deemed faulty, then a link going down indication may be sent on the 9th frame check has failed.

MIH event	802.1ag MIB objects		
	Object	Present/ Extension	Description
Link Up	Dot1agCfmCCheckRestoredEvent	Present	Detected connectivity or connectivity has been restored.
Link Down	Dot1agCfgCCheckLossEvent	Present	A MEP has lost contact with one or more MEPs. A notification (fault alarm) is sent to the management entity with the MEPID of the MEP which detected the problem.
Link Going Down	X	Extension	Number of connectivity check frames that can be lost before indicating fault is defined. "Link Going Down" signal is generated for one or more less than the count.

Table 2

[0036] Figure 6 shows an exemplary system 600 for supporting MIH services using 802.1ag OAM in accordance with the second embodiment of the present invention. The system 600 includes a UE 602, an 802.11 network 604, an 802.16 network (WIMAX) 606, an 802.3 network 608, a home network 614 and an MIH PoS 616. The 802.11 network 604 and the 802.3 network are connected to the home network 614 via 802.1Q bridges 610, 612, respectively. The UE 602 is MIH capable and supports the 802.11, 802.16 and 802.3 access technologies. The UE 602 and the MIH PoS 616 are two OAM peer entities and the link status between the UE 602 and the MIH PoS 616 are monitored by using an IEEE 802.1ag protocol as stated above. Upon detection of the 802.1ag events, an MIH

entity of the UE 602, (or the MIH PoS 616 or PoAs in the 802.11 network 604, the 802.16 network 606 and the 802.3 network 608), maps the 802.1ag MIB object to an 802.21 event and may trigger an inter-technology handover between the 802.11 network 604, the 802.16 network 606 and the 802.3 network 608, or intra-technology handover may be triggered within the currently connected network, based on the MIH event. An IEEE 802.1Q VLAN traffic can be carried over 802.3, 802.11 and 802.16 frames through the associated convergence sublayer. Thus, the end-to-end 802.1ag based connectivity is valuable to make inter-technology or intra-technology handover decisions.

[0037] Embodiments.

[0038] 1. A method for MIH using OAM protocol in a communication system including a user equipment (UE), an MIH PoS and a plurality of access networks.

[0039] 2. The method of embodiment 1, comprising the step of monitoring a link connectivity between the UE and the MIH PoS by using an OAM protocol.

[0040] 3. The method of embodiment 2, comprising the step of upon detection of a link status, mapping an OAM trigger indicating the link status to an MIH event.

[0041] 4. The method of embodiment 3, comprising the step of reporting the MIH event.

[0042] 5. The method as in any of the embodiments 2-4, wherein the OAM protocol is IEEE 802.3ah.

[0043] 6. The method of embodiment 5, wherein an 802.3ah link up event is mapped to an 802.21 link up event.

[0044] 7. The method as in any of the embodiments 5-6, wherein an 802.3ah link fault event is mapped to an 802.21 link down event.

[0045] 8. The method as in any of the embodiments 5-7, wherein an 802.3ah dying gasp event is mapped to an 802.21 link going down event.

[0046] 9. The method as in any of the embodiments 2-4, wherein the OAM protocol is IEEE 802.1ag.

[0047] 10. The method of embodiment 9, wherein an 802.1ag MIB object indicating that connectivity is detected is mapped to an 802.21 link up event.

[0048] 11. The method as in any of the embodiments 9-10, wherein an 802.1ag MIB object indicating that an MEP has lost contact with one or more MEPs is mapped to an 802.21 link down event.

[0049] 12. The method as in any of the embodiments 9-11, wherein an 802.21 link going down event is generated based on an 802.1ag MIB object indicating the number of connectivity check frames that can be lost before indicating fault.

[0050] 13. The method as in any of the embodiments 1-12, wherein the access network is an 802.1D-bridged network.

[0051] 14. The method as in any of the embodiments 1-12, wherein the access network is an 802.1Q-bridged network.

[0052] 15. A system for MIH using an OAM protocol.

[0053] 16. The system of embodiment 15, comprising a UE.

[0054] 17. The system as in any of the embodiments 15-16, comprising an MIH PoS for providing MIH services.

[0055] 18. The system as in any of the embodiments 15-17, comprising a plurality of access networks.

[0056] 19. The system of embodiment 18, wherein the UE and the MIH PoS are configured to monitor a link status between the UE and the MIH PoS by using an OAM protocol.

[0057] 20. The system of embodiment 19, the UE and the MIH PoS are configured to map an OAM trigger indicating a detected link status to an MIH event.

[0058] 21. The system of embodiment 20, the UE and the MIH PoS are configured to trigger a handover among the access networks based on the MIH event.

[0059] 22. The system as in any of the embodiments 15-21, wherein the OAM protocol is IEEE 802.3ah.

[0060] 23. The system of embodiment 22, wherein an 802.3ah link up

event is mapped to an 802.21 link up event.

[0061] 24. The system as in any of the embodiments 22-23, wherein an 802.3ah link fault event is mapped to an 802.21 link down event.

[0062] 25. The system as in any of the embodiments 22-24, wherein an 802.3ah dying gasp event is mapped to an 802.21 link going down event.

[0063] 26. The system as in any of the embodiments 15-21, wherein the OAM protocol is IEEE 802.1ag.

[0064] 27. The system of embodiment 26, wherein an 802.1ag MIB object indicating that connectivity is detected is mapped to an 802.21 link up event.

[0065] 28. The system as in any of the embodiments 26-27, wherein an 802.1ag MIB object indicating that an MEP has lost contact with one or more MEPs is mapped to an 802.21 link down event.

[0066] 29. The system as in any of the embodiments 26-28, wherein an 802.21 link going down event is generated based on an 802.1ag MIB object indicating the number of connectivity check frames that can be lost before indicating fault.

[0067] 30. The system as in any of the embodiments 18-29, wherein the access network is an 802.1D-bridged network.

[0068] 31. The system as in any of the embodiments 18-29, wherein the access network is an 802.1Q-bridged network.

[0069] 32. An apparatus for MIH using an OAM protocol in a communication system including a UE, an MIH PoS and a plurality of access networks.

[0070] 33. The apparatus of embodiment 32, comprising a lower layer entity configured to monitor a link connectivity between an UE and the MIH PoS by using an OAM protocol and send an OAM trigger indicating a detected link status.

[0071] 34. The apparatus of embodiment 33, comprising an MIH entity configured to map the OAM trigger to an MIH event and report the MIH event.

[0072] 35. The apparatus as in any of the embodiments 32-34, wherein the OAM protocol is IEEE 802.3ah.

[0073] 36. The apparatus of embodiment 35, wherein an 802.3ah link up event is mapped to an 802.21 link up event.

[0074] 37. The apparatus as in any of the embodiments 35-36, wherein an 802.3ah link fault event is mapped to an 802.21 link down event.

[0075] 38. The apparatus as in any of the embodiments 35-37, wherein an 802.3ah dying gasp event is mapped to an 802.21 link going down event.

[0076] 39. The apparatus as in any of the embodiments 32-34, wherein the OAM protocol is IEEE 802.1ag.

[0077] 40. The apparatus of embodiment 39, wherein an 802.1ag MIB object indicating that connectivity is detected is mapped to an 802.21 link up event.

[0078] 41. The apparatus as in any of the embodiments 39-40, wherein an 802.1ag MIB object indicating that an MEP has lost contact with one or more MEPs is mapped to an 802.21 link down event.

[0079] 42. The apparatus as in any of the embodiments 39-41, wherein an 802.21 link going down event is generated based on an 802.1ag MIB object indicating the number of connectivity check frames that can be lost before indicating fault.

[0080] 43. The apparatus as in any of the embodiments 32-42, wherein the access network is an 802.1D-bridged network.

[0081] 44. The apparatus as in any of the embodiments 32-42, wherein the access network is an 802.1Q-bridged network.

[0082] 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 communication system including a user equipment (UE), a media independent handover (MIH) point of service (PoS) and a plurality of access networks, a method for MIH using operation, administration and maintenance (OAM) protocol, the method comprising:

monitoring a link connectivity between the UE and the MIH PoS by using an OAM protocol;

upon detection of a link status, mapping an OAM trigger indicating the link status to an MIH event; and

reporting the MIH event.

2. The method of claim 1 wherein the OAM protocol is IEEE 802.3ah.

3. The method of claim 2 wherein an 802.3ah link up event is mapped to an 802.21 link up event.

4. The method of claim 2 wherein an 802.3ah link fault event is mapped to an 802.21 link down event.

5. The method of claim 2 wherein an 802.3ah dying gasp event is mapped to an 802.21 link going down event.

6. The method of claim 1 wherein the OAM protocol is IEEE 802.1ag.

7. The method of claim 6 wherein an 802.1ag MIB object indicating that connectivity is detected is mapped to an 802.21 link up event.

8. The method of claim 6 wherein an 802.1ag MIB object indicating that a management end point (MEP) has lost contact with one or more MEPs is mapped to an 802.21 link down event.

9. The method of claim 6 wherein an 802.21 link going down event is generated based on an 802.1ag MIB object indicating the number of connectivity check frames that can be lost before indicating fault.

10. The method of claim 1 wherein the access network is an 802.1D-bridged network.

11. The method of claim 1 wherein the access network is an 802.1Q-bridged network.

12. A system for media independent handover (MIH) using operation, administration and maintenance (OAM) protocol, the system comprising:

a user equipment (UE);

an MIH point of service (PoS) for providing MIH services; and

a plurality of access networks,

wherein the UE and the MIH PoS are configured to monitor a link status between the UE and the MIH PoS by using an OAM protocol, map an OAM trigger indicating a detected link status to an MIH event and trigger a handover among the access networks based on the MIH event.

13. The system of claim 12 wherein the OAM protocol is IEEE 802.3ah.

14. The system of claim 13 wherein an 802.3ah link up event is mapped to an 802.21 link up event.

15. The system of claim 13 wherein an 802.3ah link fault event is mapped to an 802.21 link down event.

16. The system of claim 13 wherein an 802.3ah dying gasp event is mapped to an 802.21 link going down event.

17. The system of claim 12 wherein the OAM protocol is IEEE 802.1ag.

18. The system of claim 17 wherein an 802.1ag MIB object indicating that connectivity is detected is mapped to an 802.21 link up event.

19. The system of claim 17 wherein an 802.1ag MIB object indicating that a management end point (MEP) has lost contact with one or more MEPs is mapped to an 802.21 link down event.

20. The system of claim 17 wherein an 802.21 link going down event is generated based on an 802.1ag MIB object indicating the number of connectivity check frames that can be lost before indicating fault.

21. The system of claim 12 wherein the access network is an 802.1D-bridged network.

22. The system of claim 12 wherein the access network is an 802.1Q-bridged network.

23. In a communication system including a user equipment (UE), a media independent handover (MIH) point of service (PoS) and a plurality of access networks, an apparatus for media independent handover (MIH), the apparatus comprising:

a lower layer entity configured to monitor a link connectivity between an UE and the MIH PoS by using an operation, administration and maintenance (OAM) protocol and send an OAM trigger indicating a detected link status; and

an MIH entity configured to map the OAM trigger to an MIH event and report the MIH event.

24. The apparatus of claim 23 wherein the OAM protocol is IEEE 802.3ah.

25. The apparatus of claim 24 wherein an 802.3ah link up event is mapped to an 802.21 link up event.

26. The apparatus of claim 24 wherein an 802.3ah link fault event is mapped to an 802.21 link down event.

27. The apparatus of claim 24 wherein an 802.3ah dying gasp event is mapped to an 802.21 link going down event.

28. The apparatus of claim 23 wherein the OAM protocol is IEEE 802.1ag.

29. The apparatus of claim 28 wherein an 802.1ag MIB object indicating that connectivity is detected is mapped to an 802.21 link up event.

30. The apparatus of claim 28 wherein an 802.1ag MIB object indicating that a management end point (MEP) has lost contact with one or more MEPs is mapped to an 802.21 link down event.

31. The apparatus of claim 28 wherein an 802.21 link going down event is generated based on an 802.1ag MIB object indicating the number of connectivity check frames that can be lost before indicating fault.

32. The apparatus of claim 23 wherein the access network is an 802.1D-bridged network.

33. The apparatus of claim 23 wherein the access network is an 802.1Q-bridged network.

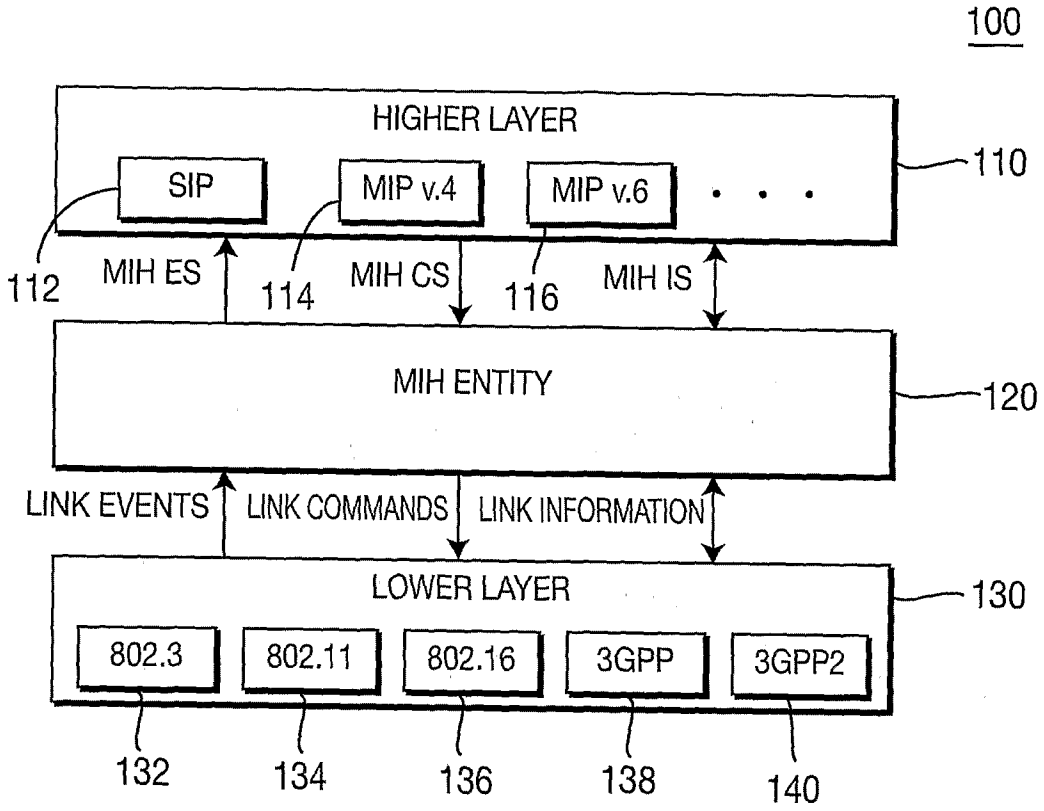
100
HIGHER LAYER
SIP
MIP v.4
MIP v.6
110
112
MIH ES
114
MIH CS
116
MIH IS
MIH ENTITY
120
LINK EVENTS
LINK COMMANDS
LINK INFORMATION
LOWER LAYER
130
802.3
802.11
802.16
3GPP
3GPP2
132
134
136
138
140

FIG. 1

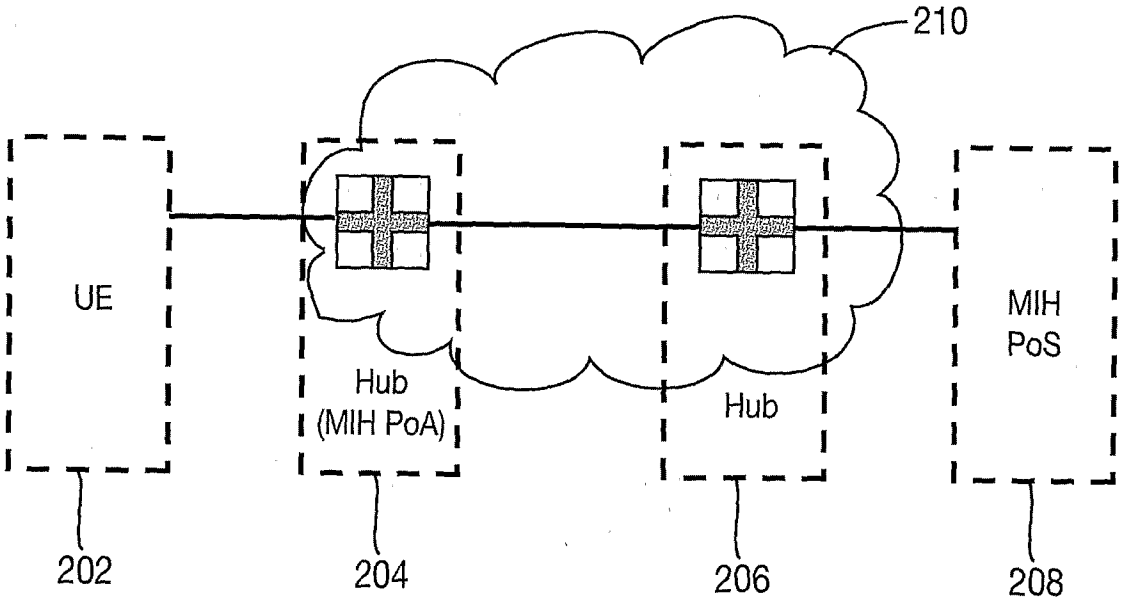
210
UE
Hub
(MIH PoA)
Hub
MIH
PoS
202
204
206
208

FIG. 2

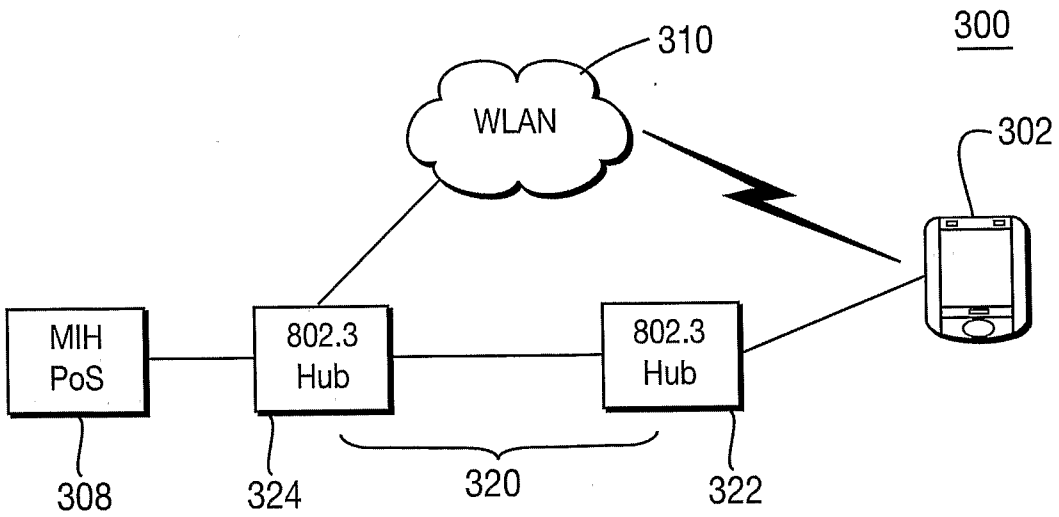
300
310
WLAN
302
MIH
PoS
802.3
Hub
802.3
Hub
308
324
320
322

FIG. 3

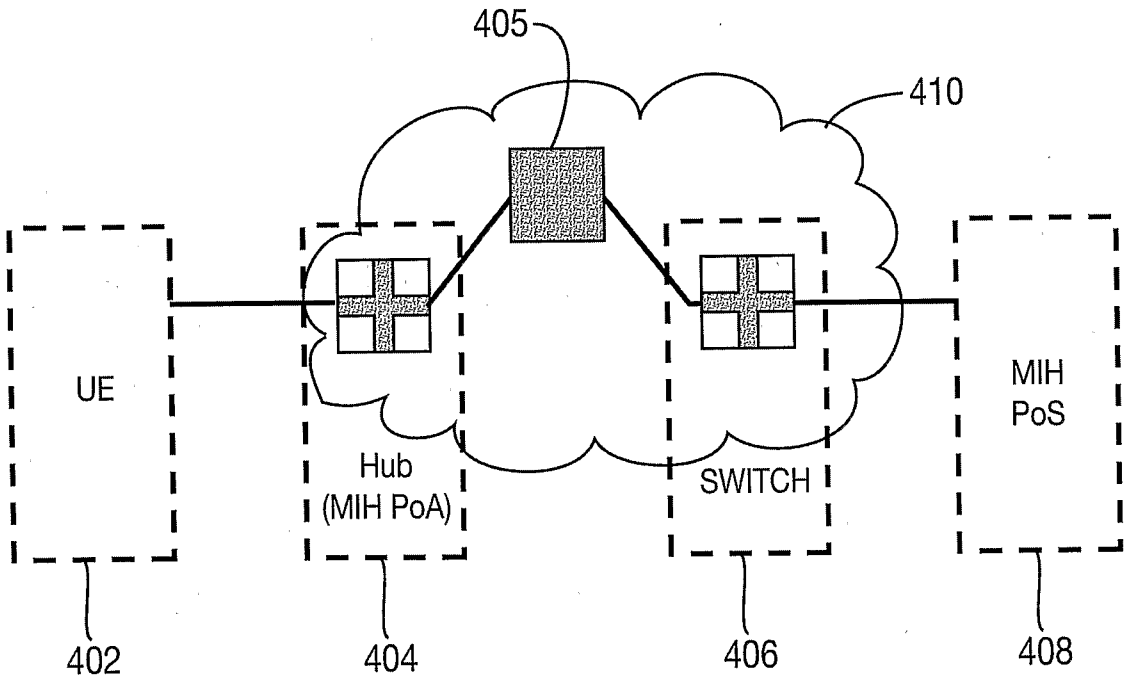
405
410
UE
Hub
(MIH PoA)
SWITCH
MIH
PoS
402
404
406
408

FIG. 4

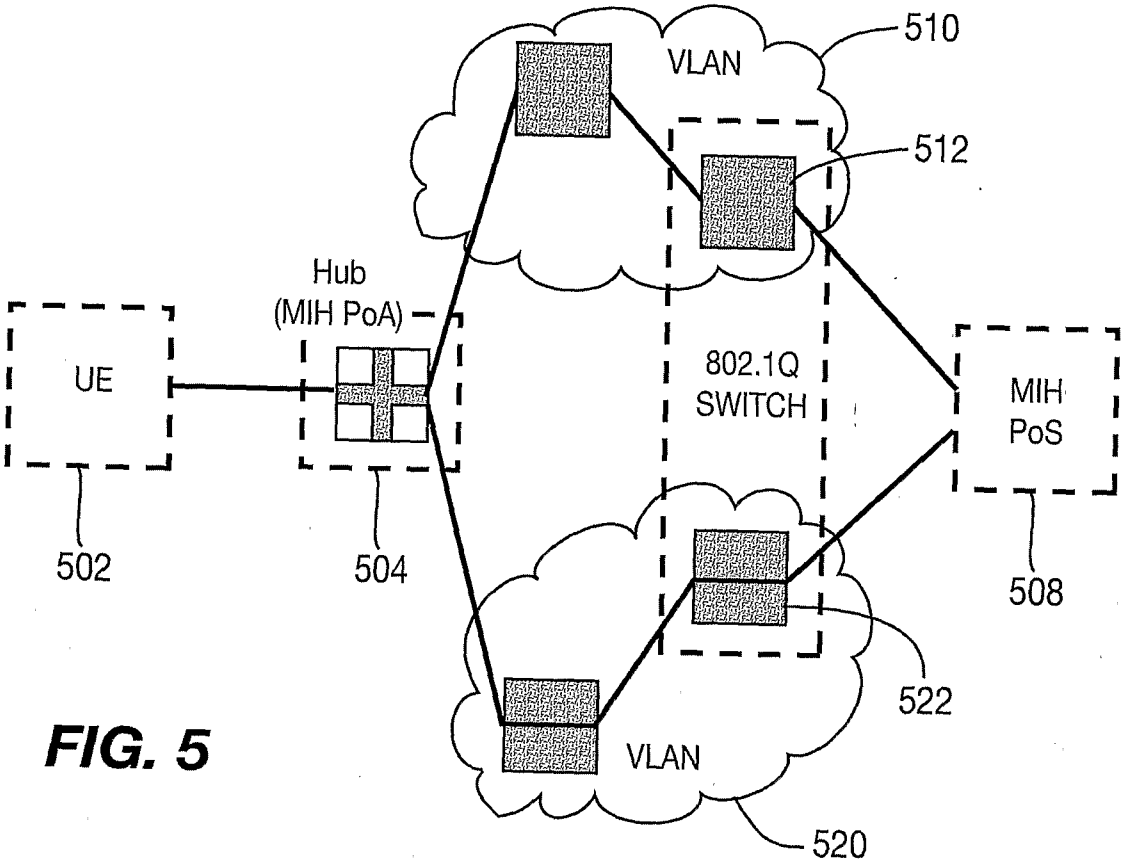
VLAN
510
512
Hub
(MIH PoA)
UE
802.1Q
SWITCH
MIH
PoS
502
504
508
522
VLAN
520

FIG. 5

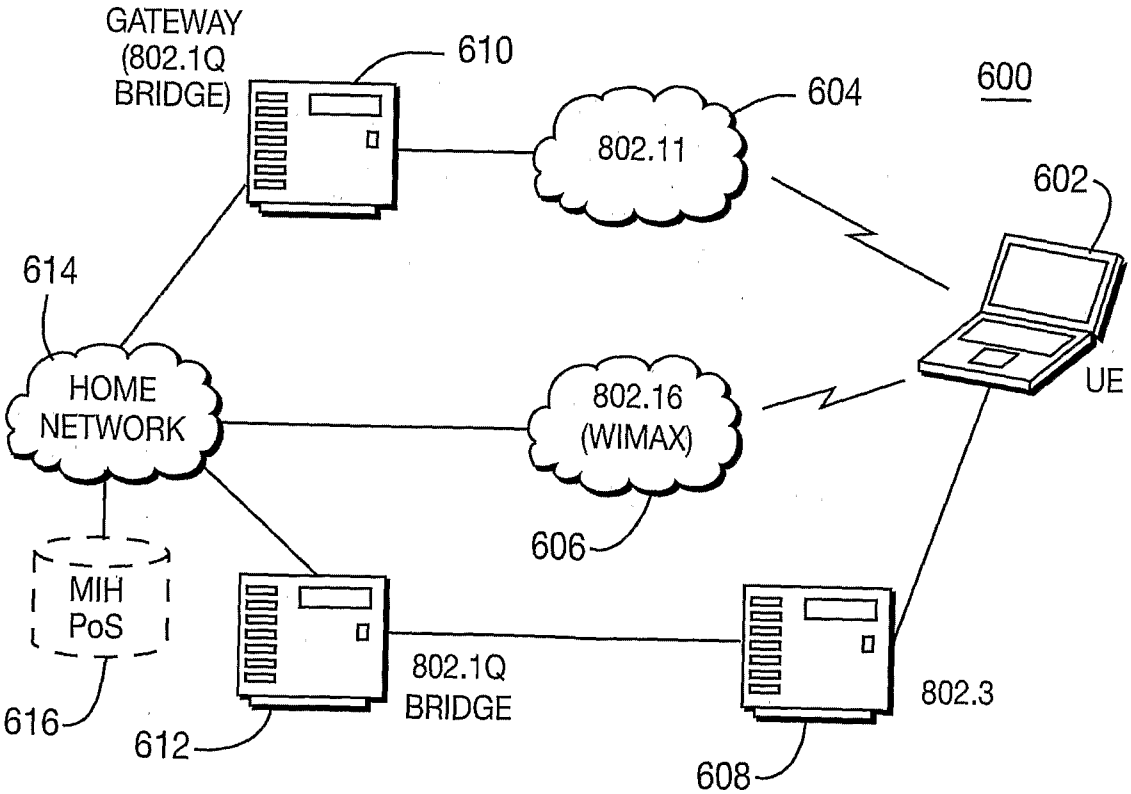
GATEWAY
(802.1Q
BRIDGE)
610
604
802.11
600
602
614
HOME
NETWORK
802.16
(WIMAX)
UE
606
MIH
PoS
802.1Q
BRIDGE
802.3
616
612
608

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2006/043723

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04Q7/38 H04L12/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04Q H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	WO 2006/078630 A (INTERDIGITAL TECH CORP [US]; OLVERA-HERNANDEZ ULISES [CA]; CARLTON ALA) 27 July 2006 (2006-07-27) paragraphs [0035] - [0042]	1-33
A	WILLIAMS M G: "DIRECTIONS IN MEDIA INDEPENDENT HANDOVER" July 2005 (2005-07), IEICE TRANSACTIONS ON FUNDAMENTALS OF ELECTRONICS, COMMUNICATIONS AND COMPUTER SCIENCES, ENGINEERING SCIENCES SOCIETY, TOKYO, JP, PAGE(S) 1772-1776 , XP001231955 ISSN: 0916-8508 paragraphs [0001] - [0003]	1-33

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 March 2007	02/04/2007

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Mele, Marco

2

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2006/043723

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GUPTA V G ET AL: "A GENERALIZED MODEL FOR LINK LAYER TRIGGERS" IEEE 802.21, XX, XX, 1 March 2004 (2004-03-01), pages 1-11, XP002344485 the whole document	1-33
T	ULISES OLVERA: "802.3 Triggers Considerations"[Online] XP002425445 Retrieved from the Internet: URL:www.ieee802.org/21/doctree/2006-09_meeting_docs/21-06-0738-00-0000-802_3Triggers.doc> [retrieved on 2007-03-19] the whole document	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2006/043723

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2006078630 A	27-07-2006	DE 202006000745 U1	14-06-2006
		KR 20060093021 A	23-08-2006
		US 2006159047 A1	20-07-2006