Office de la Propriété Intellectuelle du Canada
Un organisme d'Industrie Canada

Canadian Intellectual Property Office
An agency of Industry Canada

CA 2589333 C 2012/07/17

(11)(21) **2 589 333**

(12) **BREVET CANADIEN**
CANADIAN PATENT

(13) **C**

(86) Date de dépôt PCT/PCT Filing Date: 2005/10/31
(87) Date publication PCT/PCT Publication Date: 2006/05/18
(45) Date de délivrance/Issue Date: 2012/07/17
(85) Entrée phase nationale/National Entry: 2007/04/27
(86) N° demande PCT/PCT Application No.: US 2005/039078
(87) N° publication PCT/PCT Publication No.: 2006/052487
(30) Priorité/Priority: 2004/11/05 (US60/625,628)

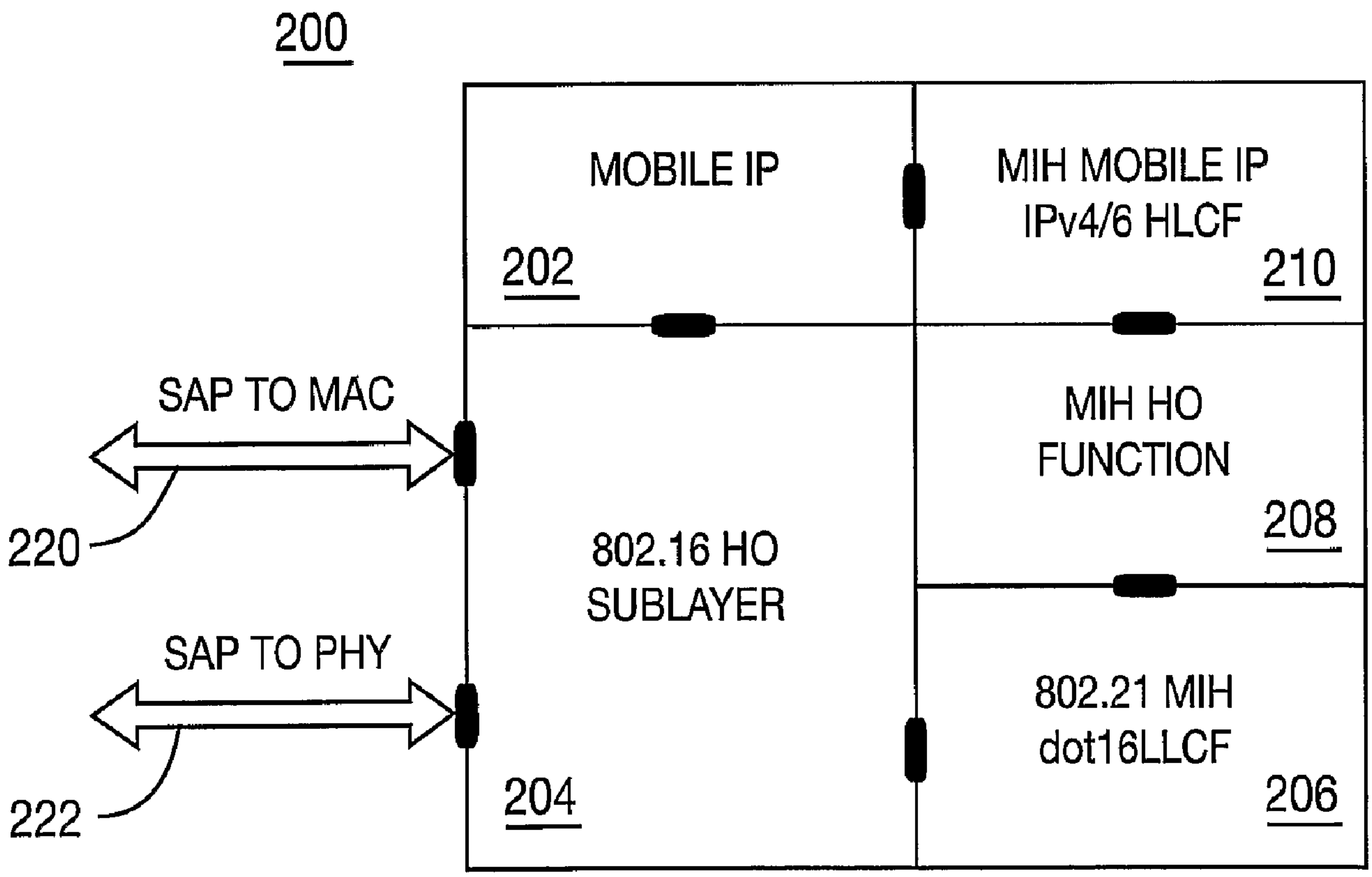
(51) Cl.Int./Int.Cl. *H04W 28/16* (2009.01), *H04W 84/04* (2009.01)
(72) Inventeurs/Inventors:
KIERNAN, BRIAN GREGORY, US;
ZAKI, MAGED M., CA

(73) Propriétaire/Owner:
INTERDIGITAL TECHNOLOGY CORPORATION, US

(74) Agent: RIDOUT & MAYBEE LLP

(54) Titre : ARCHITECTURE DE RESEAU METROPOLITAIN SANS FIL POUR GERER LES RESSOURCES DE RESEAUX ET MOBILITE ASSOCIEE

(54) Title: WIRELESS METROPOLITAN AREA NETWORK ARCHITECTURE FOR MANAGING NETWORK RESOURCES AND MOBILITY



(57) Abrégé/Abstract:
The present invention proposes an infrastructure to enable seamless mobility for wireless metropolitan area networks (WMANs) and to provide for management of spectrum and network resources. An WMAN reference model is introduced where the radio

(57) **Abrégé(suite)/Abstract(continued):**
resource management (RRM) and handover (HO) subÞlayer is introduced into the protocol stack. The WMAN management plane is responsible for the RRM and HO management. Several physical and logical network architecture options for WMAN management are proposed.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
18 May 2006 (18.05.2006)

PCT

(10) International Publication Number
WO 2006/052487 A3

(51) International Patent Classification: *H04Q 7/00* (2006.01)

(21) International Application Number: PCT/US2005/039078

(22) International Filing Date: 31 October 2005 (31.10.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/625,628 5 November 2004 (05.11.2004) US

(71) Applicant *(for all designated States except US)*: **INTERDIGITAL TECHNOLOGY CORPORATION** [US/US]; 300 Delaware Avenue, Suite 527, Wilmington, Delaware 19801 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **KIERNAN, Brian, Gregory** [US/US]; 435 Carpenter's Cove, Downingtown, Pennsylvania 19335 (US). **ZAKI, Maged** [CA/CA]; 9260 Ceres, Apt. 202, Pierrefonds, Québec H8Y 3N5 (CA).

(74) Agent: **BALLARINI, Robert, J.**; Volpe and Koenig, P.C., United Plaza, Suite 1600, 30 South 17th Street, Philadelphia, Pennsylvania 19103 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

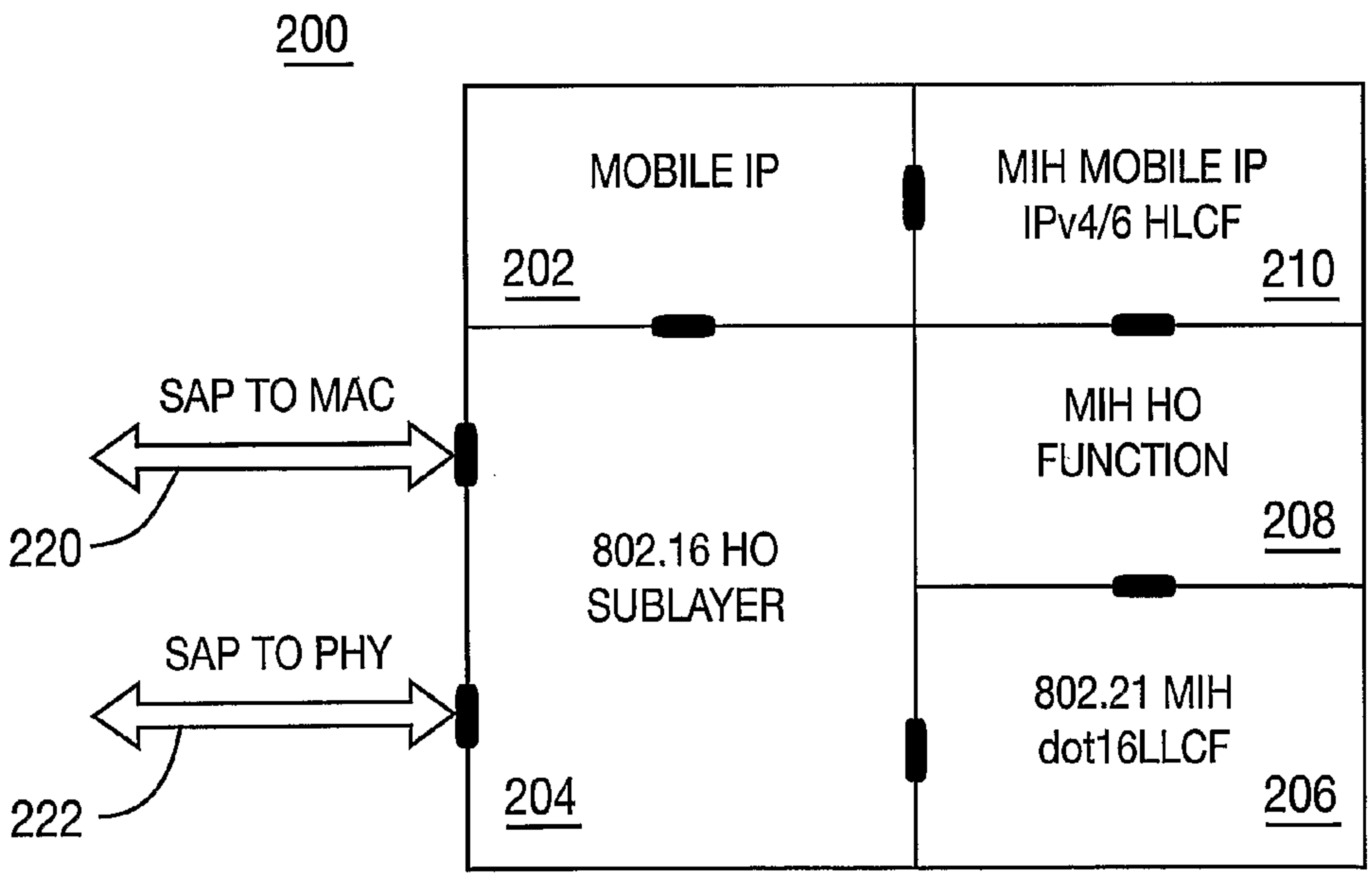
(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

(88) Date of publication of the international search report: 14 December 2006

[Continued on next page]

(54) Title: WMAN ARCHITECTURE FOR MANAGING NETWORK RESOURCES AND MOBILITY



(57) Abstract: The present invention proposes an infrastructure to enable seamless mobility for wireless metropolitan area networks (WMANs) and to provide for management of spectrum and network resources. An WMAN reference model is introduced where the radio resource management (RRM) and handover (HO) sublayer is introduced into the protocol stack. The WMAN management plane is responsible for the RRM and HO management. Several physical and logical network architecture options for WMAN management are proposed.

WO 2006/052487 A3

WO 2006/052487 A3

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

[0001] WIRELESS METROPOLITAN AREA NETWORK ARCHITECTURE FOR MANAGING NETWORK RESOURCES AND MOBILITY

[0002] FIELD OF INVENTION

[0003] The present invention relates generally to wireless metropolitan area networks (WMANs), and more particularly, to an architecture for managing network resources and mobility in a WMAN.

[0004] BACKGROUND

[0005] Wireless metropolitan area network (WMAN) standards have to define a network structure that provides the network equipment with procedures to enable management of network resources, mobility, and spectrum. This network architecture should allow the networks to perform seamless handover between different WMAN networks and harmonize the handover process with 802.21 for seamless mobility with other wireless networks (e.g., 802.11 wireless local area networks, cellular, etc.).

[0006] Current solutions do not define how WMAN network resources are managed and how users can handover seamlessly between various WMAN networks or from WMAN networks to different access technologies. There is a need to define reference models and network architectures for radio resource management (RRM) and mobility management between WMAN and heterogeneous access technologies.

[0007] SUMMARY

[0008] The present invention proposes an infrastructure to enable seamless mobility for WMAN networks and provide for management of spectrum and network resources. A network reference model is introduced where the radio resource management (RRM) and handover (HO) sublayer is introduced into the protocol stack. The network management plane is responsible for the RRM and HO management. Also, the invention proposes physical and logical network architecture options for network management.

[0009] A system for managing resources in a WMAN includes a control and data plane and a management plane. The control and data plane includes a service specific convergence sublayer, a MAC common part sublayer (CPS), and a physical sublayer. The management plane includes a service specific convergence sublayer management entity, a MAC CPS management entity, a RRM sublayer, a handover sublayer, a physical sublayer management entity, and a management service access point, through which the components of the management plane communicate with each other.

[0010] A system for managing handovers in a WMAN includes a mobile IP part; a handover sublayer, the handover sublayer being specific to a network type of the WMAN; a media independent handover (MIH) lower layer convergence function (LLCF), the LLCF being specific to a network type of the WMAN; a MIH handover function; and a MIH higher layer convergence function.

[0011] A system for managing resources in a WMAN includes a base station, a radio access gateway, a core network, and a MIH access gateway. The base station is configured to communicate with a station. The radio access gateway is configured to operate as a system management entity and to communicate with the base station. The core network communicates with the radio access gateway. The MIH access gateway is configured to perform media independent handovers and to communicate with the radio access gateway.

[0012] A system for managing resources in a WMAN includes a base station, an access gateway, and a core network. The base station is configured to communicate with a station. The access gateway communicates with the base station and includes a radio access gateway and a MIH access gateway. The MIH access gateway is configured to perform media independent handovers and to communicate with the radio access gateway. The core network communicates with the access gateway.

[0013] A system for managing resources in a WMAN includes a base station and a core network. The base station includes a MAC and physical layer device, a radio access gateway, and a MIH access gateway. The radio access gateway is configured to communicate with the MAC and physical layer device.

The MIH access gateway is configured to perform media independent handovers and to communicate with the radio access gateway. The core network communicates with the base station.

[0013a] According to an embodiment of the present disclosure there is provided a handover management plane for managing handovers in a wireless network, comprising: a mobile Internet Protocol (IP) part; a handover sublayer, the handover sublayer being specific to a type of the wireless network and configured to perform a handover within the network; a media independent handover (MIH) lower layer convergence function (LLCF), the LLCF being specific to a type of the wireless network; a MIH handover function; and a MIH higher layer convergence function.

[0013b] According to another embodiment of the present disclosure there is provided a base station, comprising: a medium access control (MAC) and physical layer device; a radio access gateway, configured to communicate with the MAC and physical layer device via a first service access point (SAP) interface; and a media independent handover (MIH) access gateway, configured to: communicate with an Internet Protocol core network and another technology type network to perform a media independent handover; and communicate with the radio access gateway via a second SAP interface, wherein the first SAP and the second SAP are of different types.

[0013c] According to another embodiment of the present disclosure there is provided a method for managing handovers in a wireless network, comprising: configuring network type-specific medium access control and physical layers to send measurements and handover triggers; sending handover triggers to a network type-specific convergence function; and communicating with a media independent handover function via the network type-specific convergence function.

[0013d] According to another embodiment of the present disclosure there is provided a radio access gateway, comprising: a first service access point (SAP)

interface, configured to interface the radio access gateway with a media independent handover access gateway; and a second SAP interface, configured to interface the radio access gateway with a base station, wherein the first SAP and the second SAP are of different types and the radio access gateway is configured to communicate using an 802.16 protocol.

[0014] BRIEF DESCRIPTION OF THE DRAWINGS

[0015] Figure 1 is a diagram of a WMAN reference model;

[0016] Figure 2 is a diagram of an 802.16g handover management plane;

[0017] Figure 3 is a diagram of a first embodiment of a WMAN logical network architecture;

[0018] Figure 4 is a diagram of a second embodiment of a WMAN logical network architecture;

[0019] Figure 5 is a diagram of a third embodiment of a WMAN logical network architecture;

[0020] Figure 6 is a diagram of a first embodiment of a WMAN physical network architecture;

[0021] Figure 7 is a diagram of a second embodiment of a WMAN physical network architecture; and

[0022] Figure 8 is a diagram of a third embodiment of a WMAN physical network architecture.

[0023] DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0024] Hereafter, the term "station" (STA) includes, but is not limited to, a wireless transmit/receive unit, a user equipment, 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 term "access point" (AP) includes, but is not limited to, a base station, a Node B, a site controller, or any other type of interfacing device in a wireless environment.

[0025] The present invention defines a generic architecture for WMAN equipment to allow for seamless mobility within a WMAN. Also, it provides for mobility between heterogeneous networks. Section 1 introduces the protocol reference model. The management plane concept is used to address mobility and network resource management. Section 2 shows the logical network architecture. Two new logical nodes are introduced, the System Management Entity (radio access gateway) and the Media Independent Handover (MIH) access gateway. Section 3 shows how the logical architecture can be mapped to different implementations.

[0026] 1. WMAN Protocol Reference Model

[0027] Figure 1 is a diagram of the proposed WMAN reference model 100. The model 100 includes a control and data plane 102 and a management plane 104. The control and data plane 102 includes a service specific convergence sublayer (CS) 110, a medium access control (MAC) common part sublayer (MAC CPS) 112, a security sublayer 114 (which is part of the MAC CPS 112), and a physical sublayer 116. The management plane 104 includes a service specific CS management entity 120, a MAC CPS management entity 122, a security sublayer 124 (which is part of the MAC CPS management entity 122), a RRM and HO sublayer 126, a physical sublayer management entity 128, and a management service access point (SAP) interface 130. While the RRM and HO sublayer 126 is shown in Figure 1 as a single layer, the RRM and HO sublayer 126 can alternatively be configured as a separate RRM sublayer and an HO sublayer or the HO layer could be a sublayer to the RRM layer.

[0028] The SAP interface 130 is used to configure the MAC layer and the physical layer, and to obtain measurements from the MAC layer and the physical layer. Additionally, the SAP interface 130 connects the RRM and HO sublayer 126 to RRM and handover functionalities, which contain RRM and handover decision-making processes. The RRM and handover functionalities are located outside the MAC management entity 122. These functionalities include the algorithms that receive inputs from the MAC management entity 122 and make RRM and handover decisions. These functionalities can be located in the SME (session management entity) in the 802 reference model.

[0029] Figure 2 is a diagram of an 802.16g-handover management plane 200. The management plane 200 includes a mobile IP part 202, an 802.16 HO sublayer 204, an 802.21 MIH dot16 lower layer convergence function (LLCF) 206, an MIH HO function 208, and an MIH mobile IP higher layer convergence function (HLCF) 210. A SAP to MAC interface 220 and a SAP to PHY interface 222 are used to connect the 802.16 HO sublayer 204 to the 802.21 MIH management plane.

[0030] Handover inside 802.16 networks is the responsibility of the 802.16 HO sublayer 204. The HO sublayer 204 configures the 802.16 MAC and physical layers to send measurements and handover triggers via the MAC and physical SAPs 220, 222, respectively. If there is a need to change the 802.16 subnet, the 802.16 HO sublayer 204 sends the triggers to the mobile IP part 202. For an inter-technology handover (e.g., 802.16 to cellular or 802.16 to 802.11), handover triggers are sent from the 802.16 HO sublayer 204 to the 802.21 MIH dot16LLCF 206. The 802.21 MIH handles the handover scenarios if there is a need to change the domain or performing a handover with other technologies.

[0031] While the management plane 200 is described in connection with an 802.16 network, the management plane can be implemented in any type of WMAN by changing the HO sublayer 204 and the LLCF 206 to correspond to the appropriate network type.

[0032] 2. WMAN Logical Network Architecture

[0033] Figures 3-5 present different WMAN logical network architectures, in which the physical and MAC layers are located inside the base station (BS). The HO sublayer is located in the system management entity, namely the radio access gateway. This system management entity can be responsible for one or more BSs in the same subnet. The MIH access gateway contains the 802.21 MIH functionality. The BS communicates with the mobile station subscriber via the U interface and communicates with another BS via the IB interface. The radio access network (RAN) is connected to the IP core network via the I-CN interface.

[0034] Figure 3 shows a first embodiment of a logical architecture 300, where all logical nodes are connected via standardized logical interfaces. The architecture 300 includes a plurality of wireless stations 302, a RAN 304, an IP core network 306, and an MIH access gateway 308. The RAN 304 includes one or more base stations (BS) 310 and at least one radio access gateway 312, which is a system management entity.

[0035] A wireless station 302 communicates with a BS 310 over the U interface 320. The BSs 310 communicate with each other over the IB interface 322. The BSs 310 communicate with the radio access gateways 312 over the A interface 324; this is a reuse of the standardized A interface between the BS and the Authentication and Service Authorization server (ASA). The radio access gateways 312 communicate with each other over the AG interface 326. The radio access gateway 312 communicates with the IP core network 306 over the I-CN interface 328. The radio access gateway 312 communicates with the MIH access gateway 308 over the I-CMIH interface 330.

[0036] Figure 4 shows a second embodiment of a logical network architecture 400. The architecture 400 includes a plurality of wireless stations 402, a RAN 404, an IP core network 406, and an MIH access gateway 408. The RAN 404 includes one or more BSs 410 and at least one radio access gateway 412, which is a system management entity.

[0037] A wireless station 402 communicates with a BS 410 over the U interface 420. The BSs 410 communicate with each other over the IB interface 422. The BSs 410 communicate with the radio access gateways 412 over the A interface 424. The radio access gateway 412 communicates with the IP core network 406 over the I-CN interface 426. The radio access gateway 412 communicates with the MIH access gateway 408 over the SAP interface 428. The IP core network 406 communicates with the MIH access gateway 408 over the I-CN' interface 430.

[0038] A third embodiment of a logical architecture 500 is shown in Figure 5. The architecture 500 includes a plurality of wireless stations 502, a RAN 504, an IP core network 506, and an MIH access gateway 508. The RAN 504 includes one or more BSs 510 and at least one radio access gateway 512, which is a system management entity.

[0039] A wireless station 502 communicates with a BS 510 over the U interface 520. The BSs 510 communicate with each other over the IB interface 522. The BSs 510 communicate with the radio access gateways 512 over the SAP interface 524. The radio access gateway 512 communicates with the IP core network 506 over the I-CN interface 526. The radio access gateway 512 communicates with the MIH access gateway 508 over the SAP interface 528. The IP core network 506 communicates with the MIH access gateway 508 over the I-CN' interface 530.

[0040] The main difference in the architecture 500 is that the radio access gateway 512 is connected to the MIH access gateway 508 via a SAP interface (528), but it is also connected to the BS 510 via another SAP interface (524).

[0041] 3. WMAN Physical Network Architecture

[0042] The three logical network architecture options 300, 400, 500 allow WMAN equipment manufacturers to map these architecture options into different physical network implementations, for example as shown in Figures 6-8.

[0043] Figure 6 is a diagram of a first embodiment of a physical network architecture 600. The architecture 600 includes a plurality of wireless stations 602, a RAN 604, an IP core network 606, and an MIH access gateway 608. The RAN 604 includes one or more BSs 610 and at least one radio access gateway 612, which is a system management entity.

[0044] A wireless station 602 communicates with a BS 610 over the U interface 620. The BSs 610 communicate with each other over the IB interface 622. The BSs 610 communicate with the radio access gateways 612 over the A interface 624. The radio access gateways 612 communicate with each other over the AG interface 626. The radio access gateways 612 communicate with the IP core network 606 over the I-CN interface 628. The radio access gateways 612 communicate with the MIH access gateway 608 over the I-CMIH interface 630. The IP core network 606 communicates with the MIH access gateway 608 over the I-CN' interface 632.

[0045] The architecture 600 includes three major physical nodes on the network side: the BS 610, which can contain only the physical layer and possibly the MAC layer; the radio access gateway 612, which contains the handover functionalities; and the MIH access gateway 608, which contains all the MIH functionalities (i.e., 802.21). The architecture 600 assumes the use of centralized handover management entities.

[0046] Figure 7 is a diagram of a second embodiment of a physical network architecture 700. The architecture 700 includes a plurality of wireless stations 702, a RAN 704, and an IP core network 706. The RAN 704 includes one or more BSs 710 and at least one access gateway 712. Each access gateway 712 includes a radio access gateway 714 and an MIH access gateway 716.

[0047] A wireless station 702 communicates with a BS 710 over the U interface 720. The BSs 710 communicate with each other over the IB interface 722. The BSs 710 communicate with the access gateways 712 over the A interface 724. The radio access gateway 714 and the MIH access gateway 716 communicate with each other over a SAP interface 726. The access gateways 712 communicate with each other over the AG interface 728. The access gateways 712 communicate with the IP core network 706 over the I-CN interface 730.

[0048] The architecture 700 is an alternative implementation for the centralized solution, where all the handover functionalities (radio network and 802.21 handover) are centralized in the access gateway 712. The radio network and 802.21 handover functionalities interface with each other via the SAP interface 726 in the access gateway 712. In the architecture 700, the BS 710 contains only the physical and MAC layers.

[0049] Figure 8 is a diagram of a third embodiment of a physical network architecture 800. The architecture 800 includes a plurality of wireless stations 802, a RAN 804, and an IP core network 806. The RAN 804 includes one or more BSs 810. Each BS 810 includes a MAC and PHY section 812, a radio access gateway 814, and an MIH access gateway 816.

[0050] A wireless station 802 communicates with a BS 810 over the U interface 820. The MAC and PHY section 812 communicates with the radio access gateway 814 over a first SAP interface 822. The radio access gateway 814 and the MIH access gateway 816 communicate with each other over a second SAP interface 824. The BSs 810 communicate with each other over the IB interface 826. The BSs 810 communicate with the IP core network 806 over the I-CN interface 828.

[0051] The architecture 800 includes a "fat" BS 810, where the radio network and 802.21 handover functionalities are implemented in the BS. The handover functionalities communicate with each other and with the Physical and MAC layers via the first and second SAPs 822, 824.

[0052] Embodiments

[0053] 1. A system for managing resources in a wireless metropolitan area network, including a control and data plane and a management plane. The control and data plane includes: a service specific convergence sublayer; a medium access control (MAC) common part sublayer (CPS); and a physical sublayer. The management plane includes a service specific convergence sublayer management entity; a MAC CPS management entity; a radio resource management and handover sublayer; a physical sublayer management entity; and a management service access point, through which the components of the management plane communicate with each other.

[0054] 2. The system according to embodiment 1, wherein the radio resource management sublayer and the handover sublayer are combined into a single sublayer.

[0055] 3. The system according to embodiment 1, wherein the handover sublayer is part of the radio resource management sublayer.

[0056] 4. The system according to one of embodiments 1-3, wherein the control and data plane further includes a security sublayer located in the MAC CPS.

[0057] 5. The system according to one of embodiments 1-4, wherein the management plane further includes a security sublayer located in the MAC CPS management entity.

[0058] 6. A system for managing handovers in a wireless metropolitan area network (WMAN) includes: a mobile Internet protocol (IP) part; a handover sublayer, the handover sublayer being specific to a network type of the WMAN; a media independent handover (MIH) lower layer convergence function (LLCF), the LLCF being specific to a network type of the WMAN; a MIH handover function; and a MIH higher layer convergence function.

[0059] 7. The system according to embodiment 6, further including: a service access point (SAP) to medium access control layer interface and a SAP to physical layer interface, the SAP interfaces enabling communication between the handover sublayer and a MIH management plane.

[0060] 8. The system according to embodiments 6 or 7, wherein the handover sublayer is configured to perform handover within the network.

[0061] 9. The system according to embodiments 6 or 7, wherein the handover sublayer is configured to perform handover between sub-networks, the handover sublayer signaling the mobile IP part to execute the handover.

[0062] 10. The system according to embodiments 6 or 7, wherein the handover sublayer is configured to perform handover between different technologies, the handover sublayer signaling the LLCF to execute the handover.

[0063] 11. A system for managing resources in a wireless metropolitan area network includes: a base station, configured to communicate with a station; a radio access gateway, configured to operate as a system management entity, the radio access gateway communicating with the base station; a core network communicating with the radio access gateway; and a medium independent handover (MIH) access gateway, configured to perform media independent handovers, the MIH access gateway communicating with the radio access gateway.

[0064] 12. The system according to embodiment 11, wherein the base station communicates with a station via a U interface.

[0065] 13. The system according to embodiments 11 or 12, wherein the base station communicates with the radio access gateway via an A interface.

[0066] 14. The system according to one of embodiments 11-13, wherein the radio access gateway communicates with the core network via an I-CN interface.

[0067] 15. The system according to one of embodiments 11-15, wherein the radio access gateway communicates with the MIH access gateway via an I-CMIH interface.

[0068] 16. The system according to one of embodiments 11-15, wherein the system includes more than one base station communicating with the radio access gateway and each base station is configured to communicate with another base station via an IB interface.

[0069] 17. The system according to one of embodiments 11-16, wherein the system includes more than one radio access gateway and each radio access gateway is configured to communicate with another radio access gateway via an AG interface.

[0070] 18. The system according to one of embodiments 11-14, 16, or 17, wherein the radio access gateway communicates with the MIH access gateway via a service access point interface.

[0071] 19. The system according to one of embodiments 11-18, wherein the core network communicates with the MIH access gateway via an I-CN' interface.

[0072] 20. The system according to one of embodiments 11, 12, 14, 16, 18, or 19, wherein the base station communicates with the radio access gateway via a service access point interface.

[0073] 21. A system for managing resources in a wireless metropolitan area network includes: a base station, configured to communicate with a station; an access gateway communicating with the base station, the access gateway including a radio access gateway and a media independent handover (MIH) access gateway, configured to perform media independent handovers, the MIH access gateway communicating with the radio access gateway; and a core network communicating with the access gateway.

[0074] 22. The system according to embodiment 21, wherein the base station communicates with a station via a U interface.

[0075] 23. The system according to embodiments 21 or 22, wherein the base station communicates with the access gateway via an A interface.

[0076] 24. The system according to one of embodiments 21-23, wherein the radio access gateway communicates with the MIH access gateway via a service access point interface.

[0077] 25. The system according to one of embodiments 21-24, wherein the access gateway communicates with the core network via an I-CN interface.

[0078] 26. The system according to one of embodiments 21-25, wherein the system includes more than one base station communicating with the access gateway and each base station is configured to communicate with another base station via an IB interface.

[0079] 27. The system according to one of embodiments 21-26, wherein the system includes more than one access gateway and each access gateway is configured to communicate with another access gateway via an AG interface.

[0080] 28. A system for managing resources in a wireless metropolitan area network includes a base station and a core network communicating with the base station. The base station includes: a medium access control (MAC) and physical layer device; a radio access gateway, configured to communicate with the MAC and physical layer device; and a media independent handover (MIH) access gateway, configured to perform media independent handovers, the MIH access gateway communicating with the radio access gateway.

[0081] 29. The system according to embodiment 28, wherein the base station communicates with a station via a U interface.

[0082] 30. The system according to embodiments 28 or 29, wherein the MAC and physical layer device communicates with the radio access gateway via a service access point interface.

[0083] 31. The system according to one of embodiments 28-30, wherein the radio access gateway communicates with the MIH access gateway via a service access point interface.

[0084] 32. The system according to one of embodiments 28-31, wherein the base station communicates with the core network via an I-CN interface.

[0085] 33. The system according to one of embodiments 28-32, wherein the system includes more than one base station, the base stations communicating with each other via an IB interface.

[0086] While the present invention has been described in connection with a WMAN and some examples have been provided relating to an 802.16-based network, the principles of the present invention (in particular, the management plane procedures and services and the media independent handover functionality) are applicable to any type of wireless network.

[0087] 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. While the present invention has been described in terms of preferred embodiments, other variations which are within the scope of the invention as outlined in the claims below will be apparent to those skilled in the art.

* * *

CLAIMS

What is claimed is:

1. A handover management plane for managing handovers in a wireless network, comprising:

a mobile Internet Protocol (IP) part;

a handover sublayer, the handover sublayer being specific to a type of the wireless network and configured to perform a handover within the network;

a media independent handover (MIH) lower layer convergence function (LLCF), the LLCF being specific to a type of the wireless network;

a MIH handover function; and

a MIH higher layer convergence function.

2. The handover management plane according to claim 1, further comprising:

a service access point (SAP) to medium access control layer interface; and

a SAP to physical layer interface;

the SAP interfaces enabling communication between the handover sublayer and a MIH management plane.

3. The handover management plane according to claim 1, wherein the handover sublayer is further configured to perform a handover between sub-networks, the handover sublayer signaling the mobile IP part to execute the handover.

4. The handover management plane according to claim 1, wherein the handover sublayer is further configured to perform a handover between different technologies, the handover sublayer signaling the LLCF to execute the handover.

5. A base station, comprising:

a medium access control (MAC) and physical layer device;

a radio access gateway, configured to communicate with the MAC and physical layer device via a first service access point (SAP) interface; and

a media independent handover (MIH) access gateway, configured to:

communicate with an Internet Protocol core network and another technology type network to perform a media independent handover; and

communicate with the radio access gateway via a second SAP interface,

wherein the first SAP and the second SAP are of different types.

6. The base station according to claim 5, wherein the base station communicates with a station via a U interface.

7. The base station according to claim 5, wherein the base station communicates with a core network via an I-CN interface.

8. The base station according to claim 5, wherein the radio access gateway is configured to communicate using an 802.16 protocol.

9. A method for managing handovers in a wireless network, comprising:

configuring network type-specific medium access control and physical layers to send measurements and handover triggers;

sending handover triggers to a network type-specific convergence function; and

communicating with a media independent handover function via the network type-specific convergence function.

10. A radio access gateway, comprising:

a first service access point (SAP) interface, configured to interface the radio access gateway with a media independent handover access gateway; and

a second SAP interface, configured to interface the radio access gateway with a base station,

wherein the first SAP and the second SAP are of different types and the radio access gateway is configured to communicate using an 802.16 protocol.

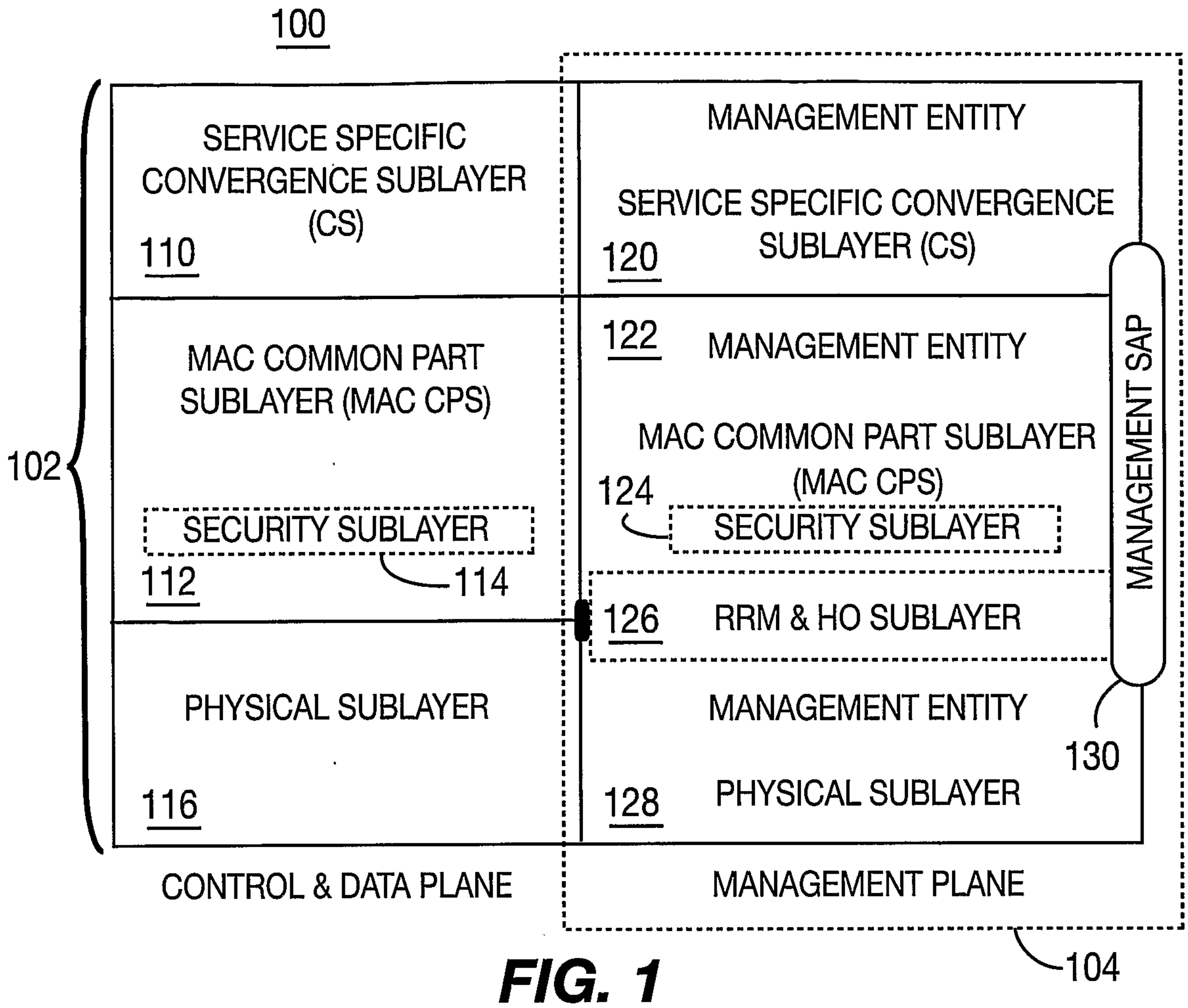

100
SERVICE SPECIFIC CONVERGENCE SUBLAYER (CS)
110
MANAGEMENT ENTITY
SERVICE SPECIFIC CONVERGENCE SUBLAYER (CS)
120
MAC COMMON PART SUBLAYER (MAC CPS)
122
MANAGEMENT ENTITY
MAC COMMON PART SUBLAYER (MAC CPS)
124
SECURITY SUBLAYER
SECURITY SUBLAYER
112
114
126
RRM & HO SUBLAYER
MANAGEMENT SAP
102
PHYSICAL SUBLAYER
116
MANAGEMENT ENTITY
130
PHYSICAL SUBLAYER
128
CONTROL & DATA PLANE
MANAGEMENT PLANE
104

FIG. 1

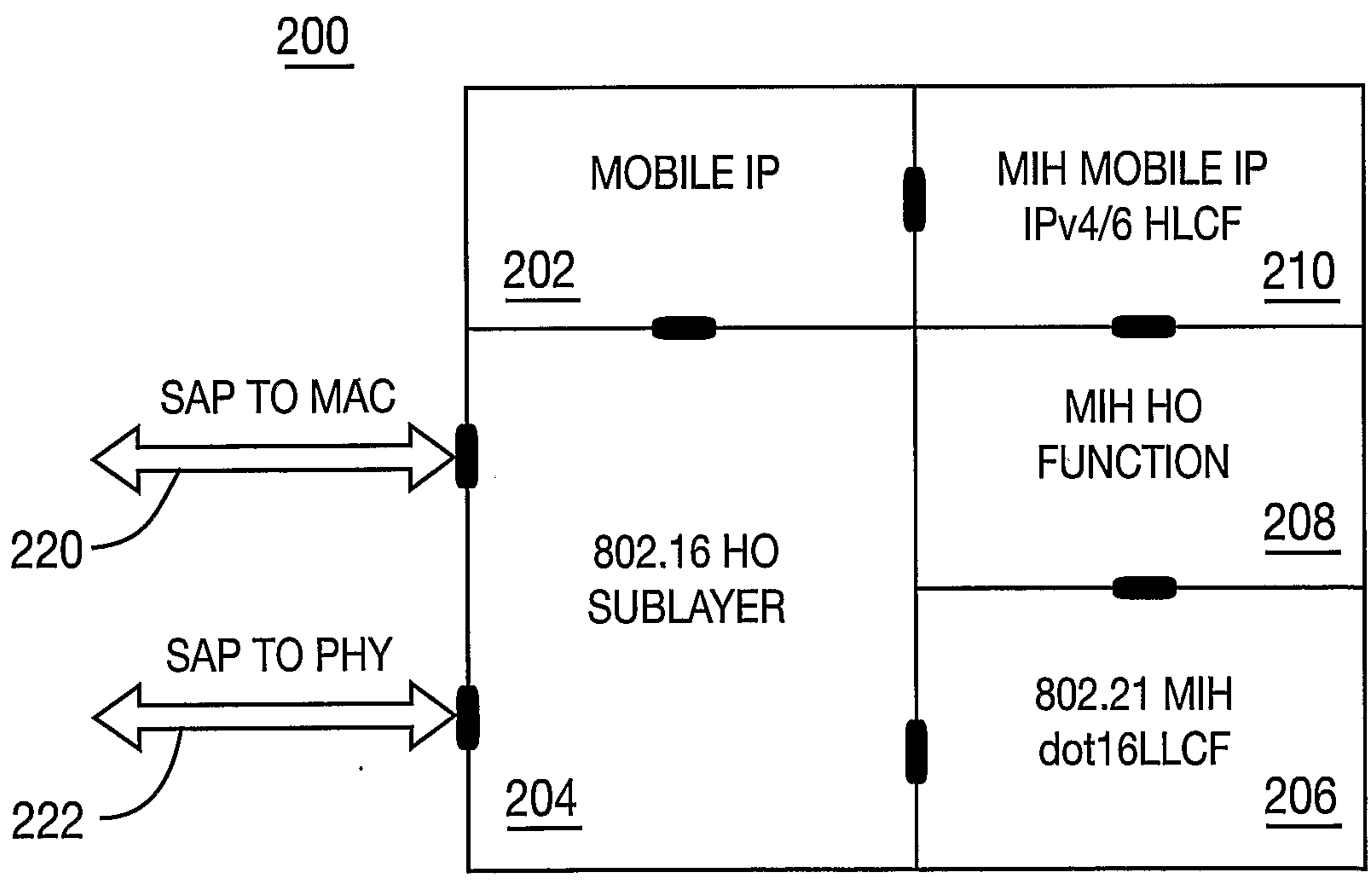

200
MOBILE IP
202
MIH MOBILE IP
IPv4/6 HLCF
210
SAP TO MAC
220
MIH HO
FUNCTION
208
802.16 HO
SUBLAYER
SAP TO PHY
222
802.21 MIH
dot16LLCF
206
204

FIG. 2

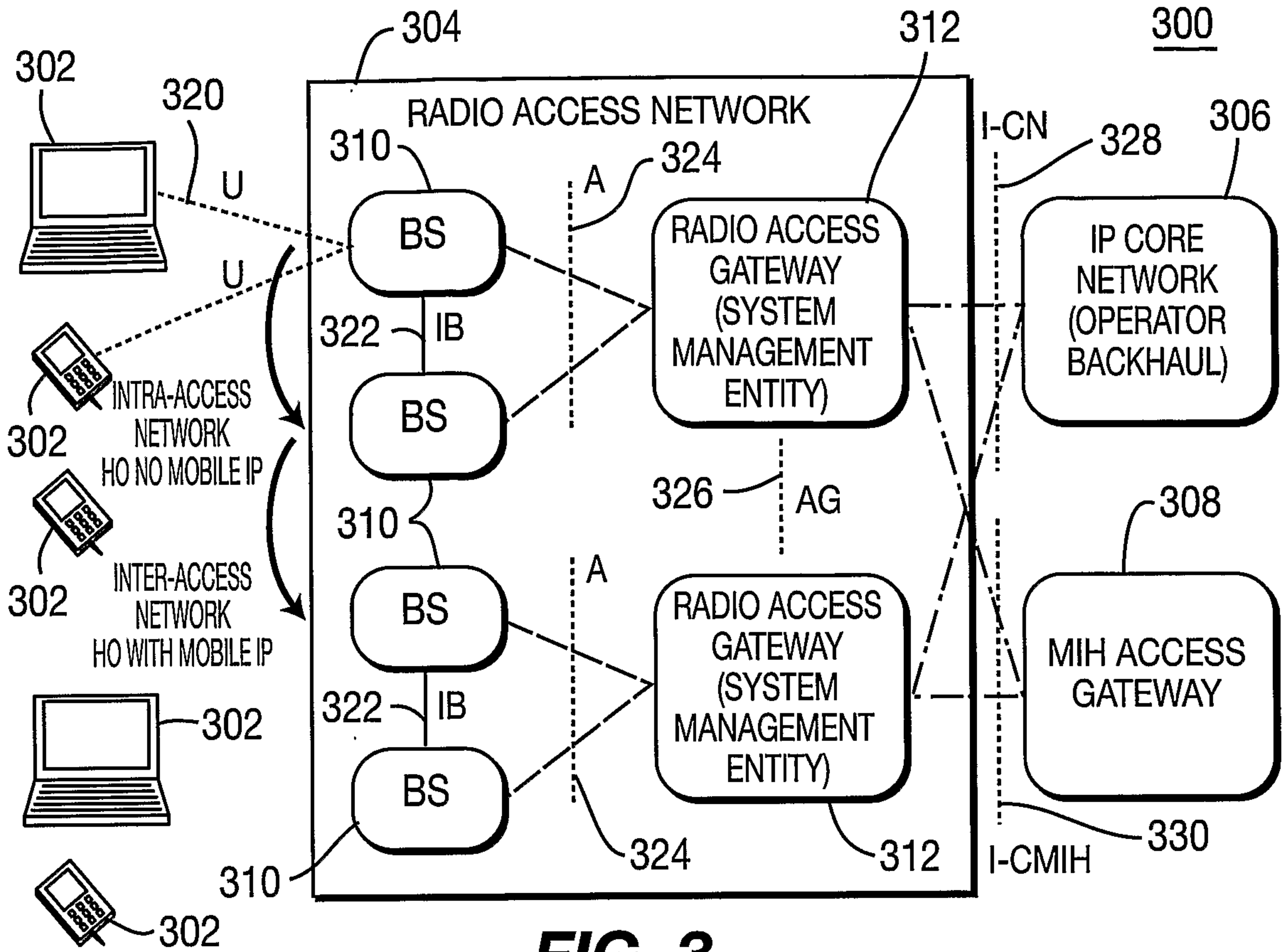

300
304
RADIO ACCESS NETWORK
302
320
U
U
310
BS
322
IB
BS
310
BS
322
IB
BS
310
324
A
RADIO ACCESS GATEWAY (SYSTEM MANAGEMENT ENTITY)
312
326
AG
A
RADIO ACCESS GATEWAY (SYSTEM MANAGEMENT ENTITY)
324
312
I-CN
328
306
IP CORE NETWORK (OPERATOR BACKHAUL)
308
MIH ACCESS GATEWAY
330
I-CMIH
INTRA-ACCESS NETWORK HO NO MOBILE IP
INTER-ACCESS NETWORK HO WITH MOBILE IP
302
302
302
302

FIG. 3

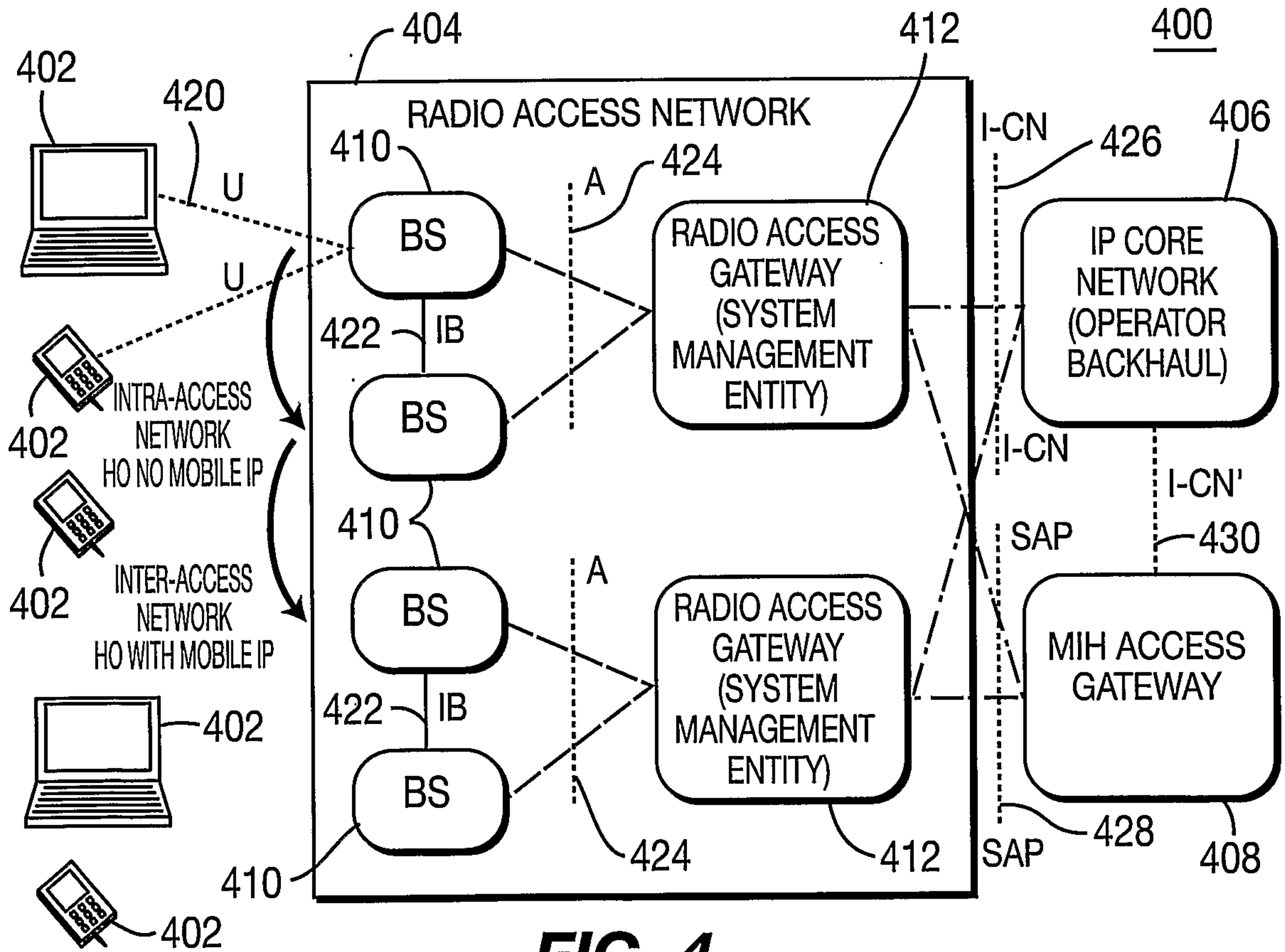

400
404
RADIO ACCESS NETWORK
402
420
U
U
410
BS
422
IB
BS
410
BS
422
IB
BS
410
424
A
RADIO ACCESS GATEWAY (SYSTEM MANAGEMENT ENTITY)
412
A
RADIO ACCESS GATEWAY (SYSTEM MANAGEMENT ENTITY)
424
412
I-CN
426
406
IP CORE NETWORK (OPERATOR BACKHAUL)
I-CN
I-CN'
SAP
430
MIH ACCESS GATEWAY
SAP
428
408
INTRA-ACCESS NETWORK HO NO MOBILE IP
INTER-ACCESS NETWORK HO WITH MOBILE IP
402
402
402
402

FIG. 4

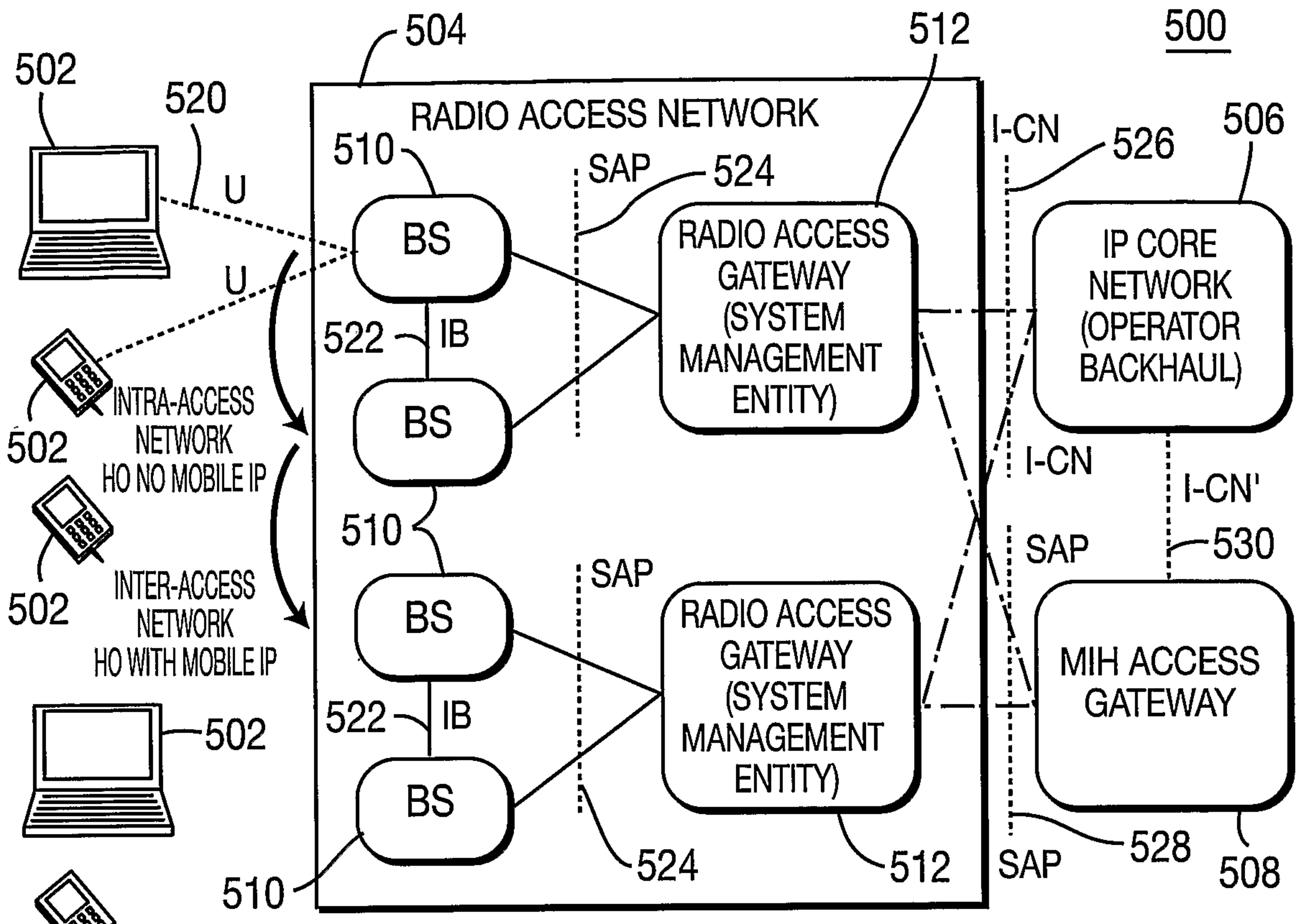

500
504
RADIO ACCESS NETWORK
502
520
U
U
510
SAP
524
512
BS
522
IB
BS
RADIO ACCESS GATEWAY (SYSTEM MANAGEMENT ENTITY)
I-CN
526
506
IP CORE NETWORK (OPERATOR BACKHAUL)
INTRA-ACCESS NETWORK HO NO MOBILE IP
INTER-ACCESS NETWORK HO WITH MOBILE IP
510
BS
522
IB
BS
SAP
RADIO ACCESS GATEWAY (SYSTEM MANAGEMENT ENTITY)
I-CN
I-CN'
530
SAP
MIH ACCESS GATEWAY
524
512
SAP
528
508
510
502

FIG. 5

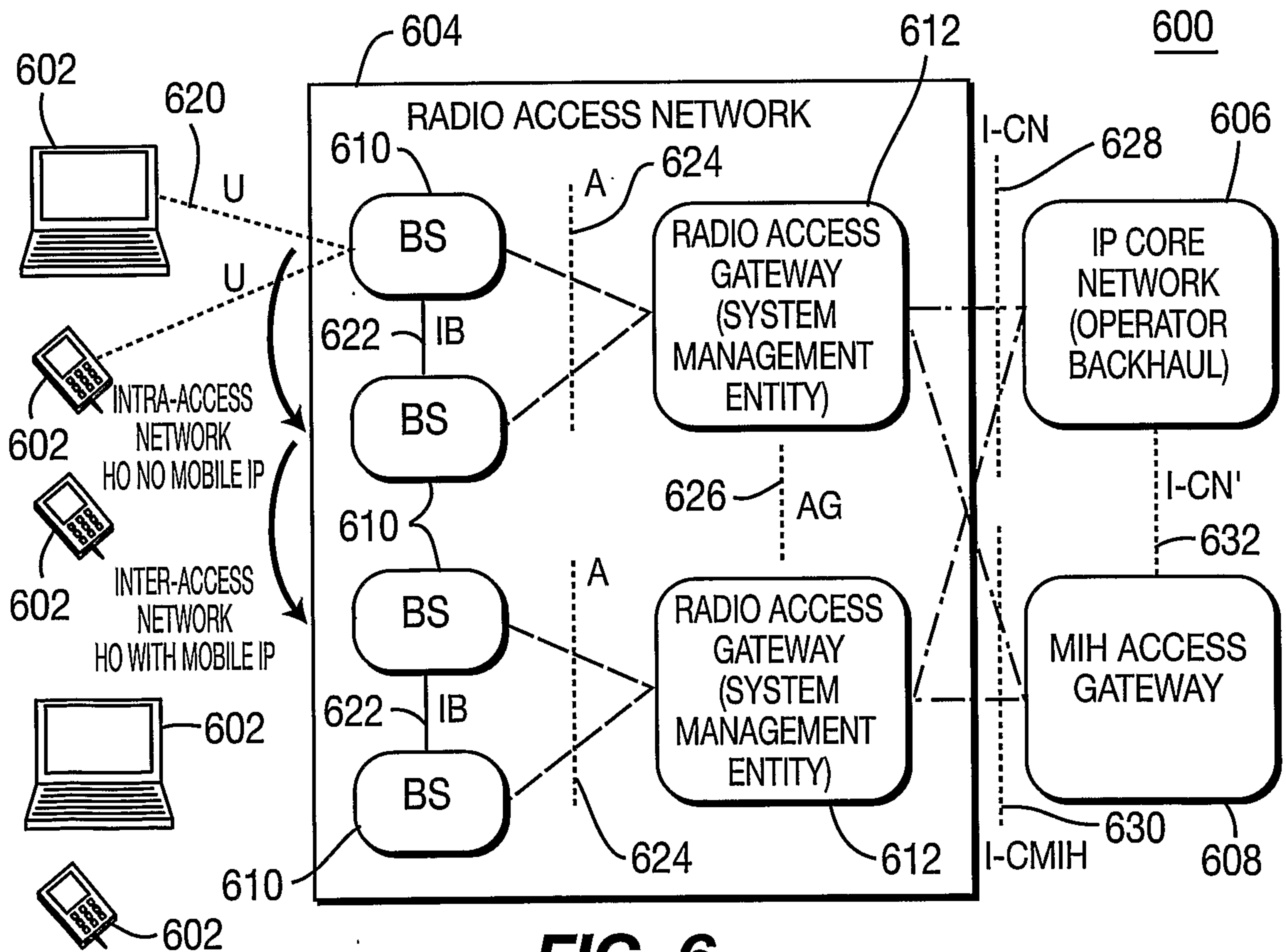

600
604
RADIO ACCESS NETWORK
602
620
U
U
610
A
624
612
BS
622
IB
BS
RADIO ACCESS GATEWAY (SYSTEM MANAGEMENT ENTITY)
I-CN
628
606
IP CORE NETWORK (OPERATOR BACKHAUL)
INTRA-ACCESS NETWORK HO NO MOBILE IP
INTER-ACCESS NETWORK HO WITH MOBILE IP
626
AG
610
A
BS
622
IB
BS
RADIO ACCESS GATEWAY (SYSTEM MANAGEMENT ENTITY)
I-CN'
632
MIH ACCESS GATEWAY
624
612
I-CMIH
630
608
610
602

FIG. 6

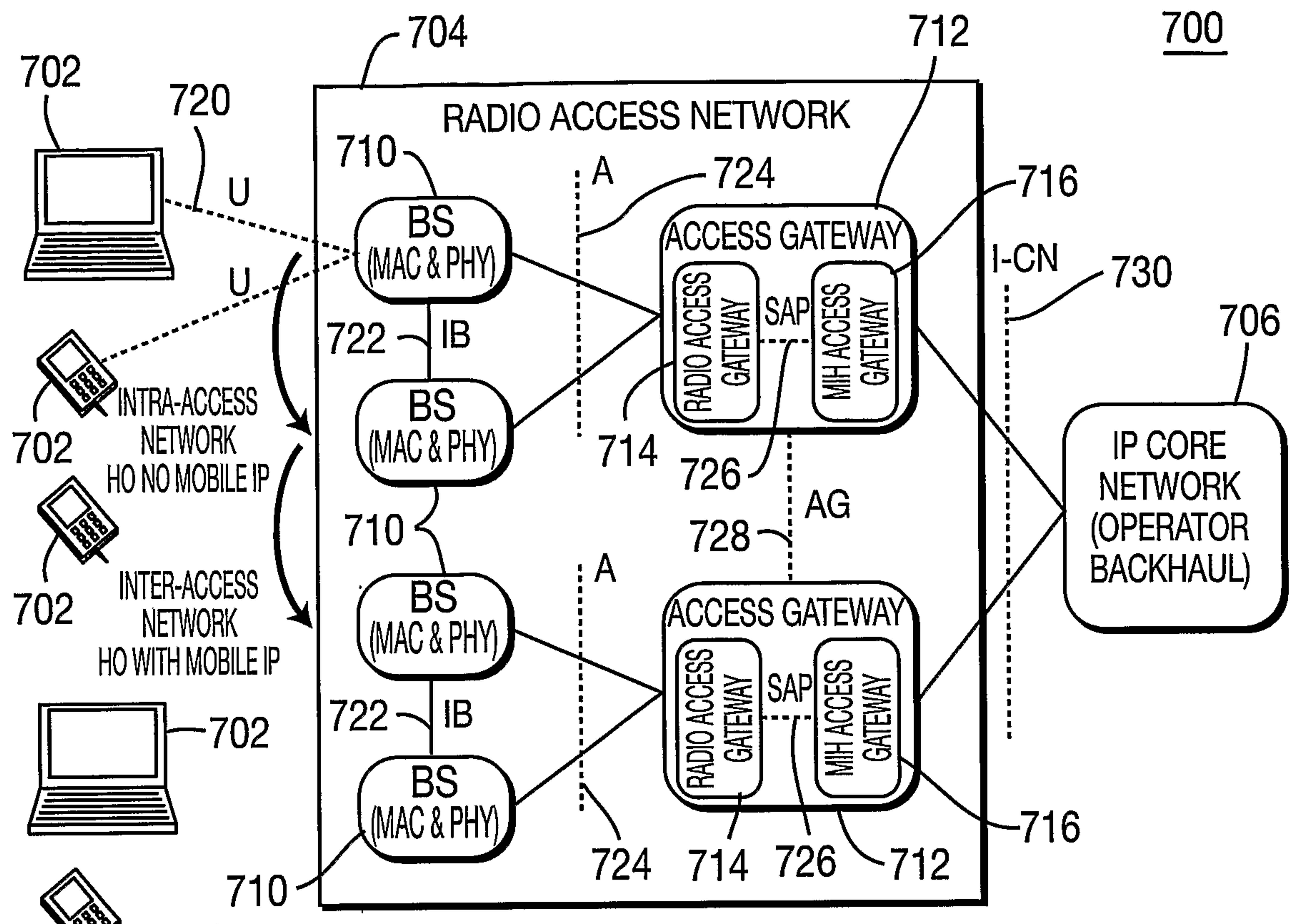

700
704
RADIO ACCESS NETWORK
702
720
U
U
710
BS (MAC & PHY)
722
IB
BS (MAC & PHY)
710
BS (MAC & PHY)
722
IB
BS (MAC & PHY)
710
INTRA-ACCESS NETWORK HO NO MOBILE IP
INTER-ACCESS NETWORK HO WITH MOBILE IP
A
724
712
ACCESS GATEWAY
RADIO ACCESS GATEWAY
SAP
MIH ACCESS GATEWAY
716
714
726
AG
728
A
ACCESS GATEWAY
RADIO ACCESS GATEWAY
SAP
MIH ACCESS GATEWAY
724
714
726
712
716
I-CN
730
706
IP CORE NETWORK (OPERATOR BACKHAUL)

FIG. 7

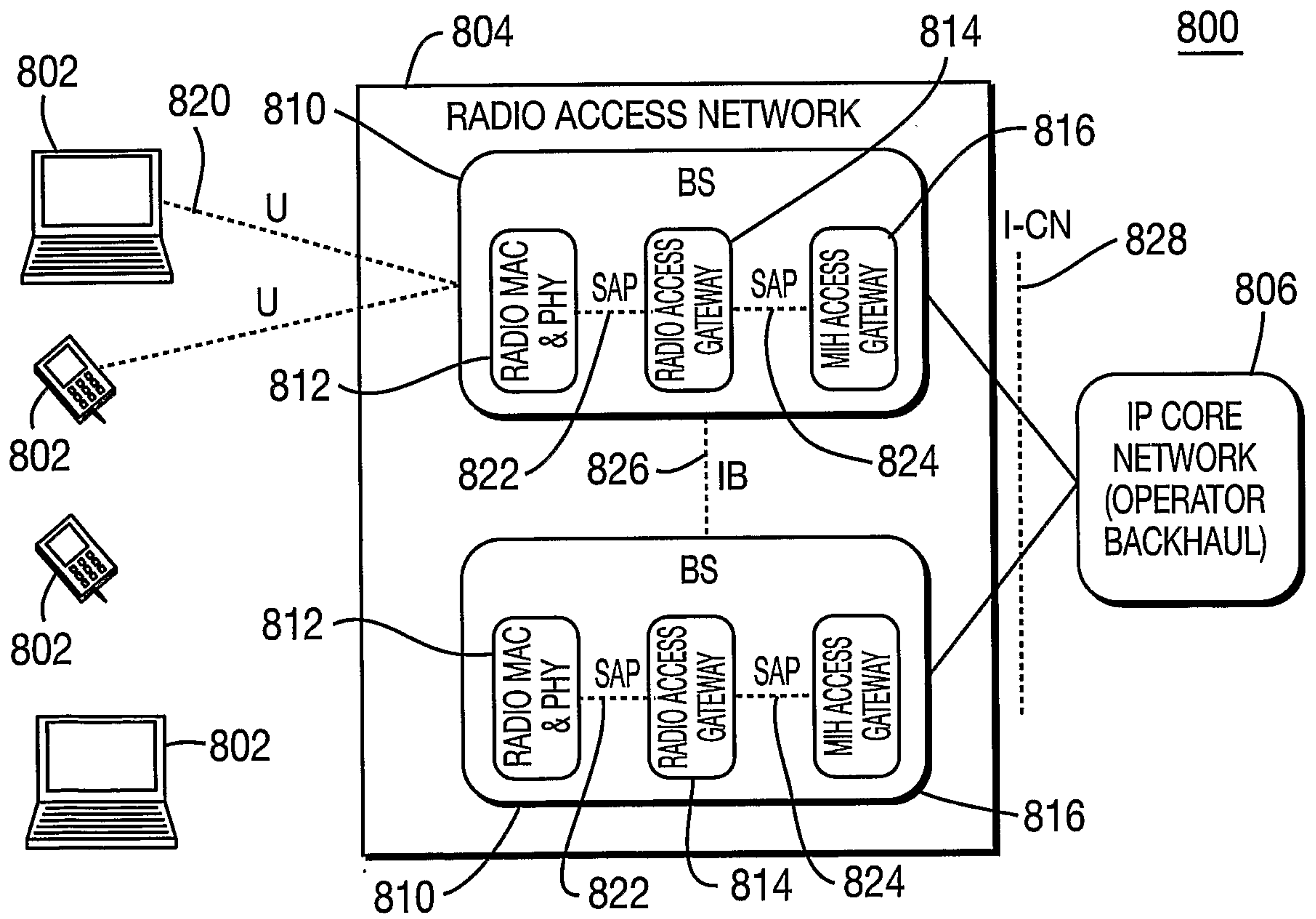
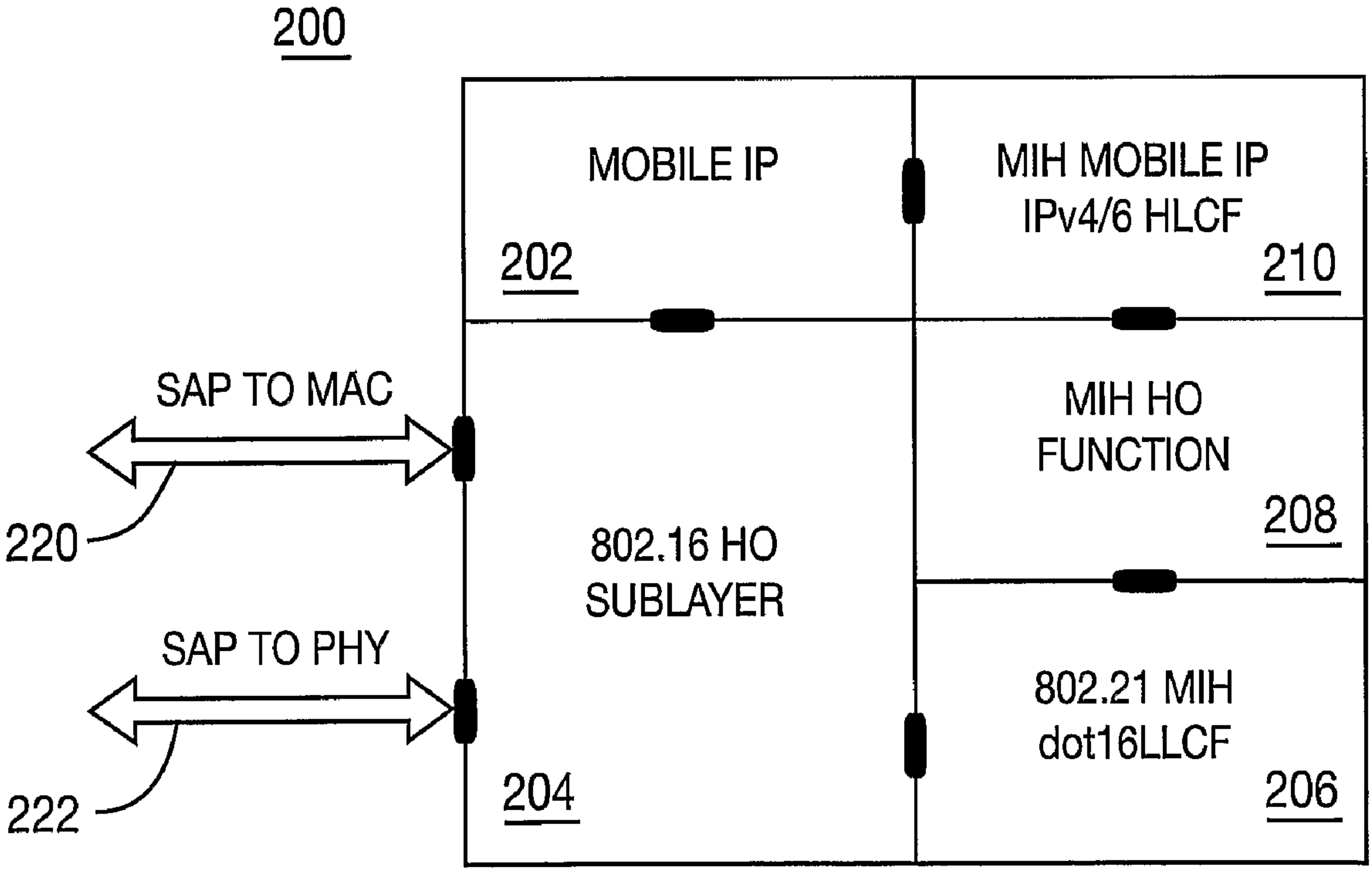

800
804
RADIO ACCESS NETWORK
802
820
U
U
810
BS
RADIO MAC & PHY
SAP
RADIO ACCESS GATEWAY
SAP
MIH ACCESS GATEWAY
814
816
812
822
826
IB
824
BS
812
RADIO MAC & PHY
SAP
RADIO ACCESS GATEWAY
SAP
MIH ACCESS GATEWAY
816
810
822
814
824
I-CN
828
806
IP CORE NETWORK (OPERATOR BACKHAUL)

FIG. 8


200
MOBILE IP
202
MIH MOBILE IP
IPv4/6 HLCF
210
SAP TO MAC
220
MIH HO
FUNCTION
208
802.16 HO
SUBLAYER
SAP TO PHY
222
802.21 MIH
dot16LLCF
204
206