US009271255B1

(12) **United States Patent**
Jones

(10) **Patent No.: US 9,271,255 B1**
(45) **Date of Patent: Feb. 23, 2016**

(54) **PROVIDING WIRELESS NETWORK COMMUNICATION AMONG A PLURALITY OF WIRELESS DEVICES**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 88 days.

(21) Appl. No.: **14/098,414**

(22) Filed: **Dec. 5, 2013**

(51) **Int. Cl.**
H04W 60/04 (2009.01)
H04W 74/02 (2009.01)

(52) **U.S. Cl.**
CPC ***H04W 60/04*** (2013.01); ***H04W 74/02*** (2013.01)

(58) **Field of Classification Search**
CPC H04W 74/02; H04W 60/04
USPC 455/435.1; 370/328–331, 338, 392
See application file for complete search history.

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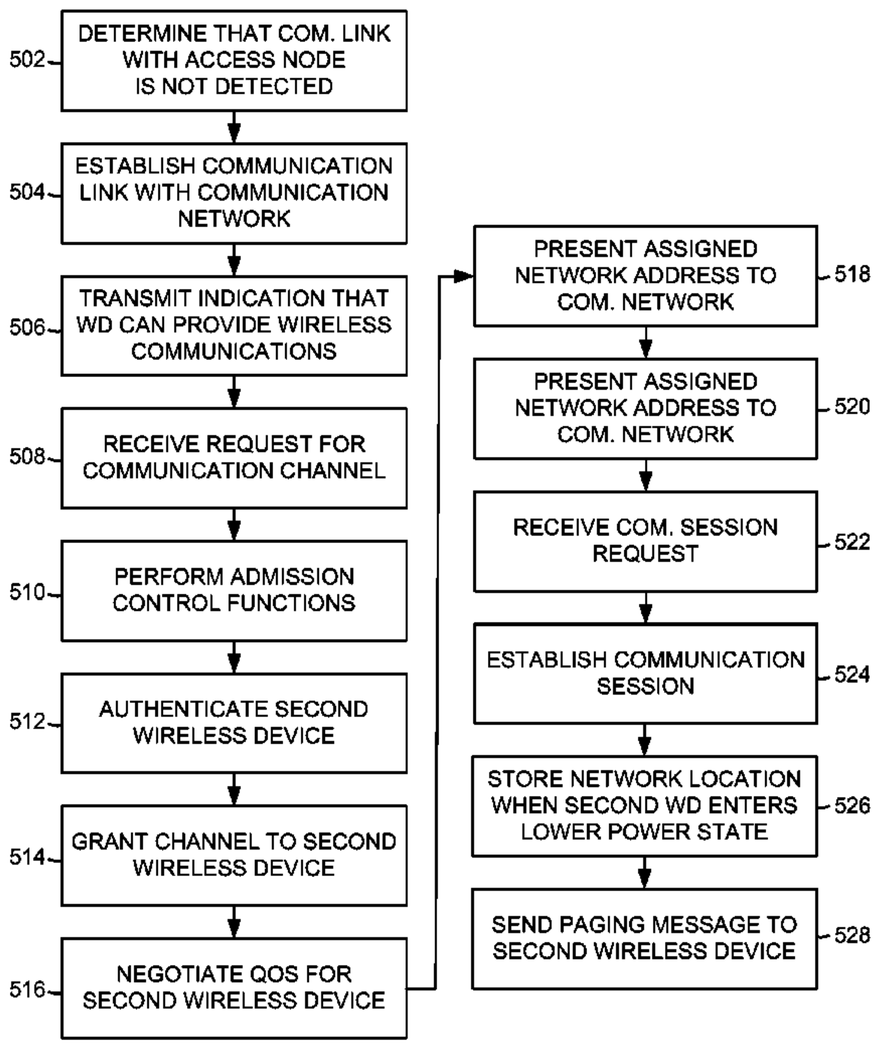
Primary Examiner — Nathan Taylor

(57) **ABSTRACT**

A communication link is established between a first wireless device and a communication network using a network communication protocol when it is determined at the first wireless device that a communication link with an access node is not detected. The first wireless device transmits an indication that the first wireless device can provide wireless communications to a second wireless device using a cellular radio access technology. In response to a communication channel request from the second wireless device, the first wireless device grants a communication channel to the second wireless device, and the second wireless device is assigned a network address. A request is received at the first wireless device to establish a communication session for the second wireless device over the communication network, and the communication session is established by the wireless device for the second wireless device over the communication network.

17 Claims, 7 Drawing Sheets



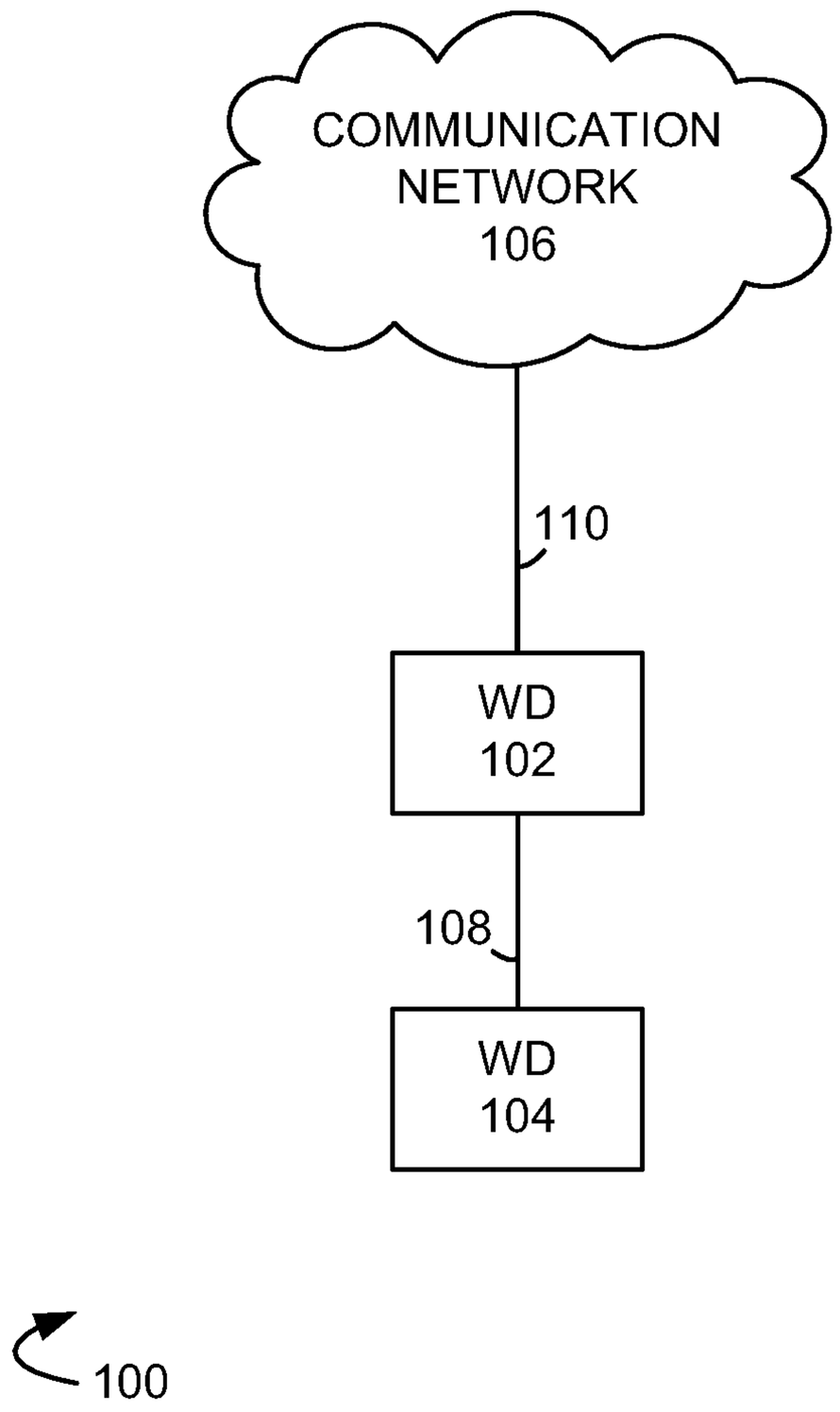


FIG. 1

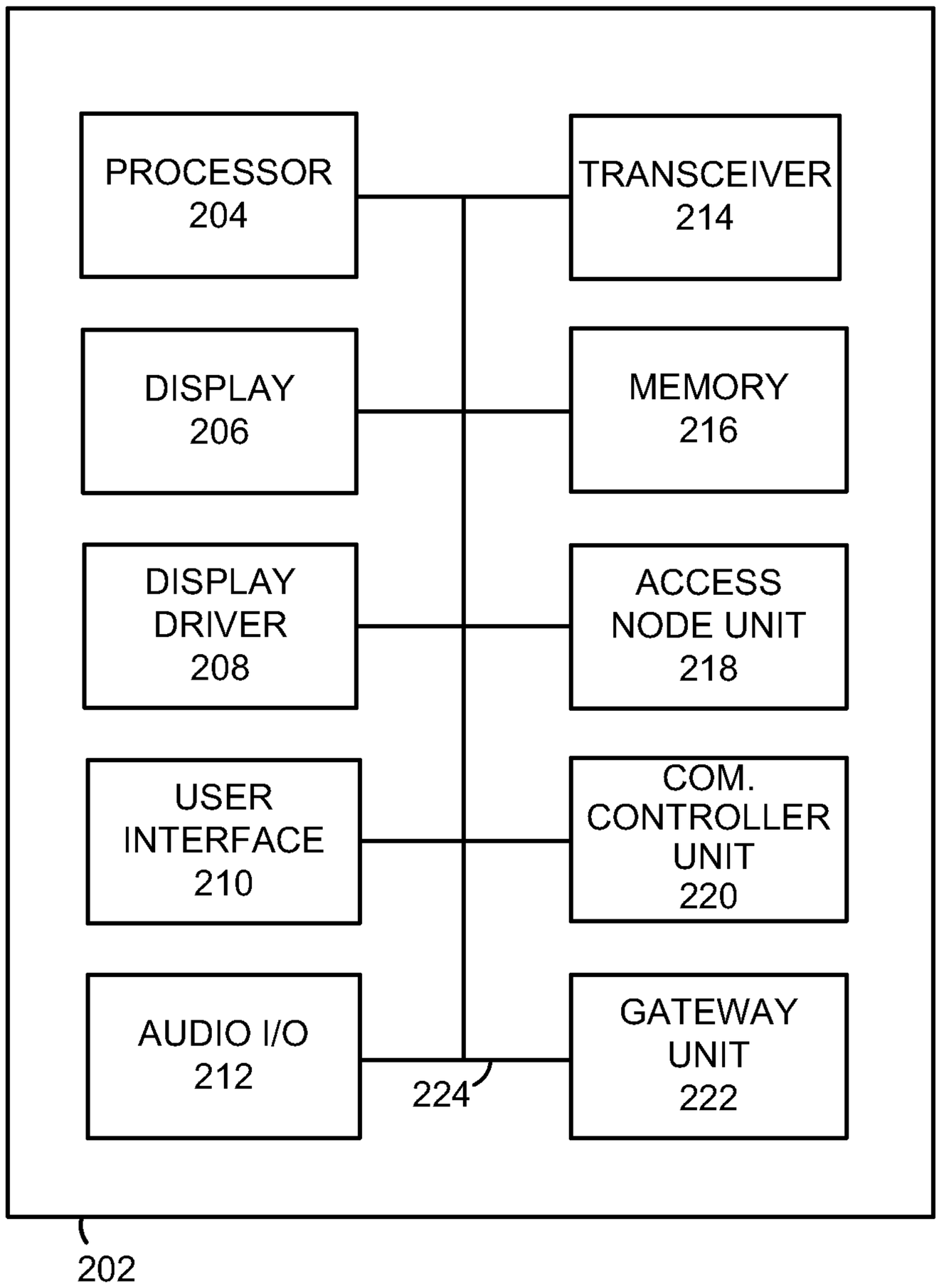
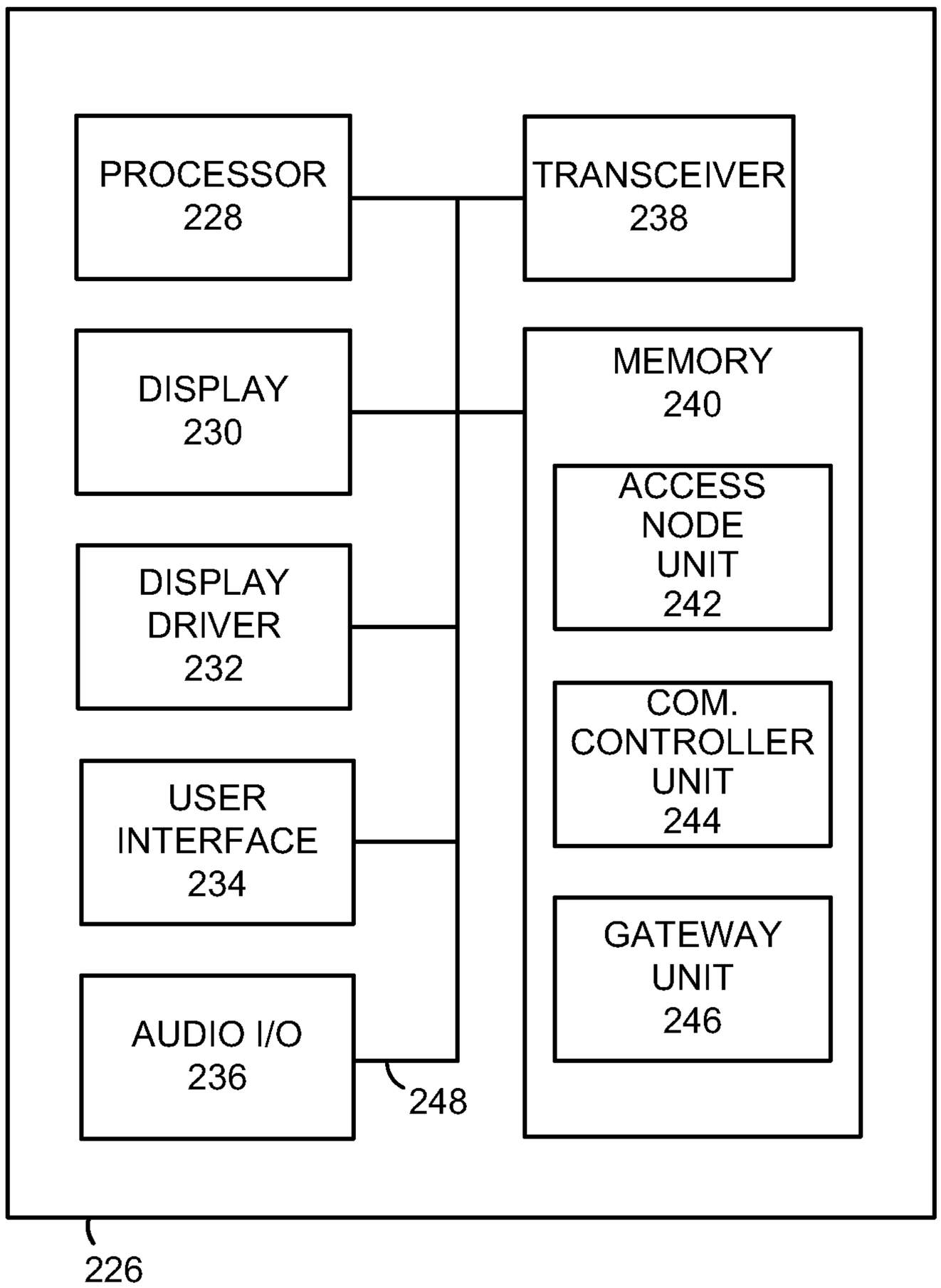

PROCESSOR
204
TRANSCEIVER
214
DISPLAY
206
MEMORY
216
DISPLAY
DRIVER
208
ACCESS
NODE UNIT
218
USER
INTERFACE
210
COM.
CONTROLLER
UNIT
220
AUDIO I/O
212
GATEWAY
UNIT
222
224
202

FIG. 2A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DISPLAY
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ACCESS
NODE
UNIT
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DISPLAY
DRIVER
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CONTROLLER
UNIT
244
USER
INTERFACE
234
GATEWAY
UNIT
246
AUDIO I/O
236
248
226

FIG. 2B

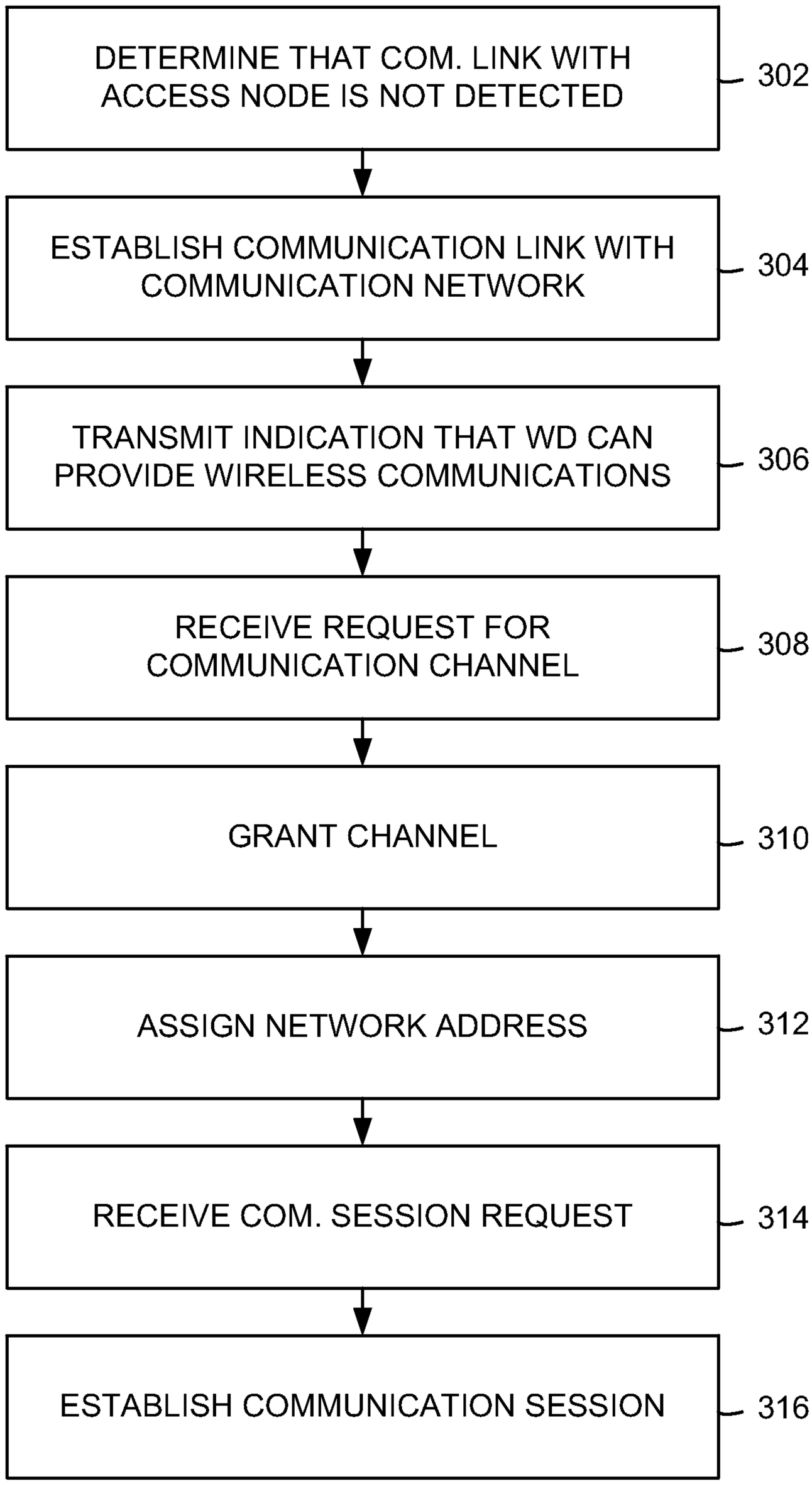
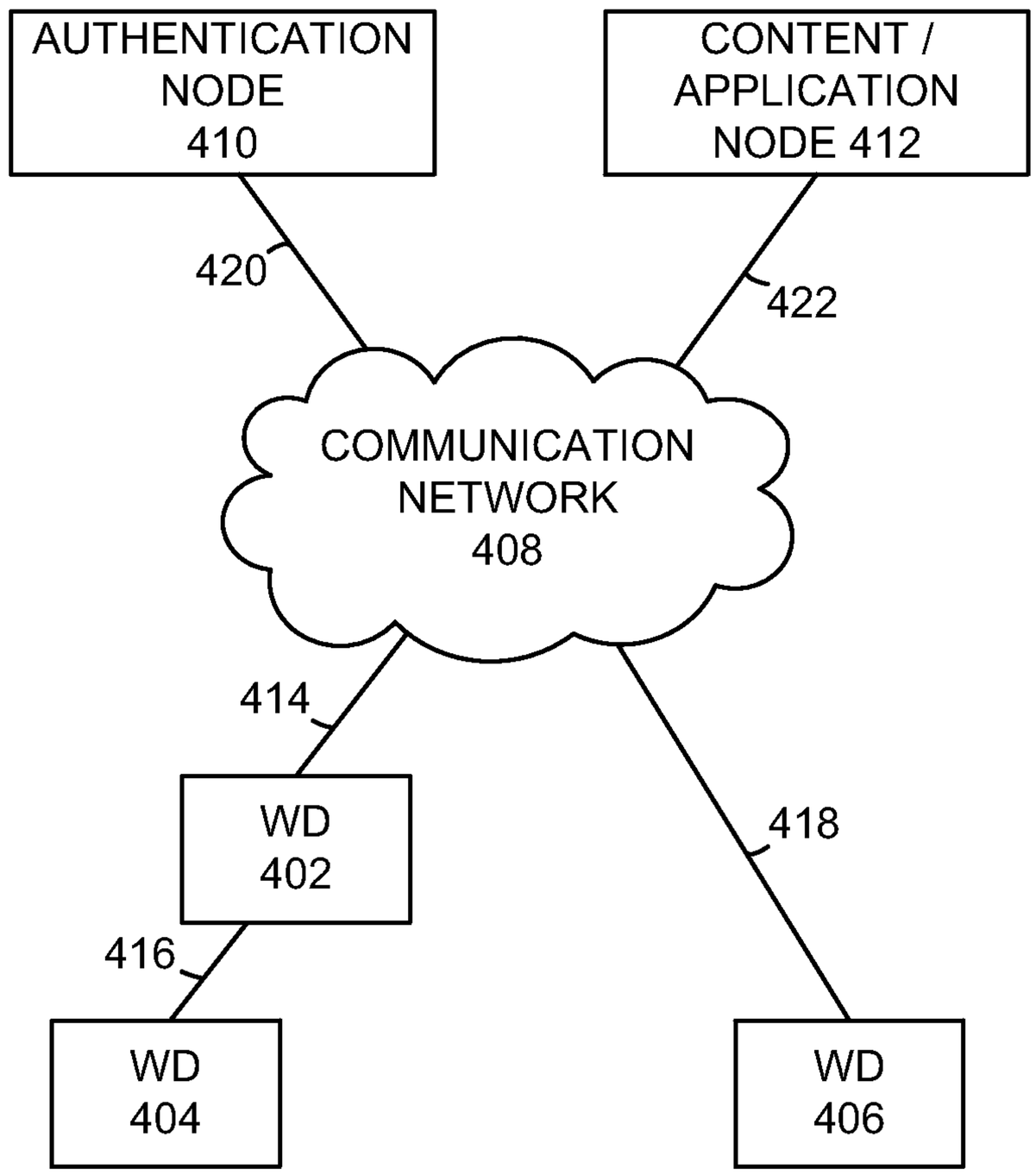

DETERMINE THAT COM. LINK WITH ACCESS NODE IS NOT DETECTED
302
ESTABLISH COMMUNICATION LINK WITH COMMUNICATION NETWORK
304
TRANSMIT INDICATION THAT WD CAN PROVIDE WIRELESS COMMUNICATIONS
306
RECEIVE REQUEST FOR COMMUNICATION CHANNEL
308
GRANT CHANNEL
310
ASSIGN NETWORK ADDRESS
312
RECEIVE COM. SESSION REQUEST
314
ESTABLISH COMMUNICATION SESSION
316

FIG. 3


AUTHENTICATION NODE 410
CONTENT / APPLICATION NODE 412
420
422
COMMUNICATION NETWORK 408
414
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WD 402
416
WD 404
WD 406
400

FIG. 4

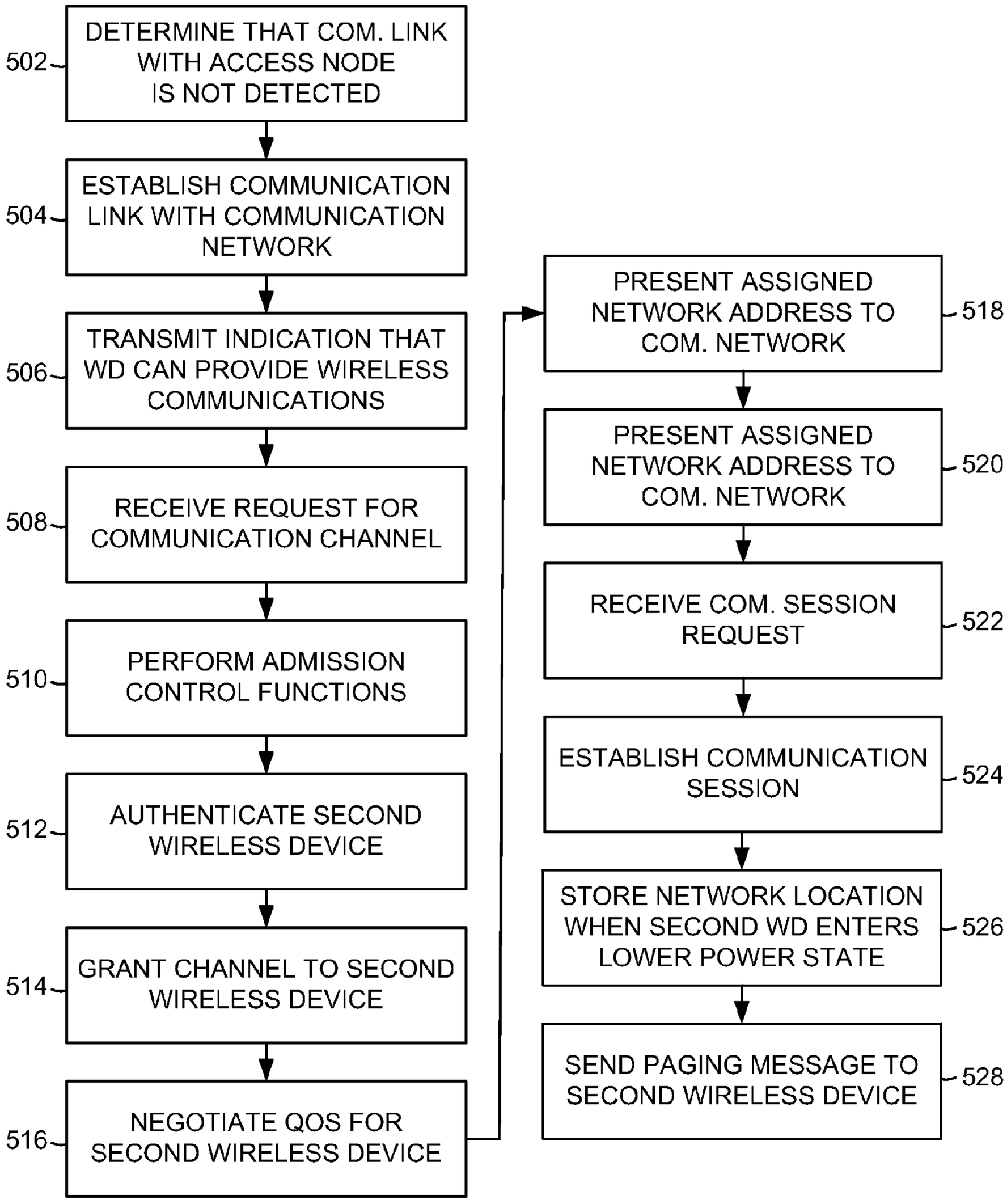
DETERMINE THAT COM. LINK WITH ACCESS NODE IS NOT DETECTED
502
ESTABLISH COMMUNICATION LINK WITH COMMUNICATION NETWORK
504
TRANSMIT INDICATION THAT WD CAN PROVIDE WIRELESS COMMUNICATIONS
506
RECEIVE REQUEST FOR COMMUNICATION CHANNEL
508
PERFORM ADMISSION CONTROL FUNCTIONS
510
AUTHENTICATE SECOND WIRELESS DEVICE
512
GRANT CHANNEL TO SECOND WIRELESS DEVICE
514
NEGOTIATE QOS FOR SECOND WIRELESS DEVICE
516
PRESENT ASSIGNED NETWORK ADDRESS TO COM. NETWORK
518
PRESENT ASSIGNED NETWORK ADDRESS TO COM. NETWORK
520
RECEIVE COM. SESSION REQUEST
522
ESTABLISH COMMUNICATION SESSION
524
STORE NETWORK LOCATION WHEN SECOND WD ENTERS LOWER POWER STATE
526
SEND PAGING MESSAGE TO SECOND WIRELESS DEVICE
528

FIG. 5

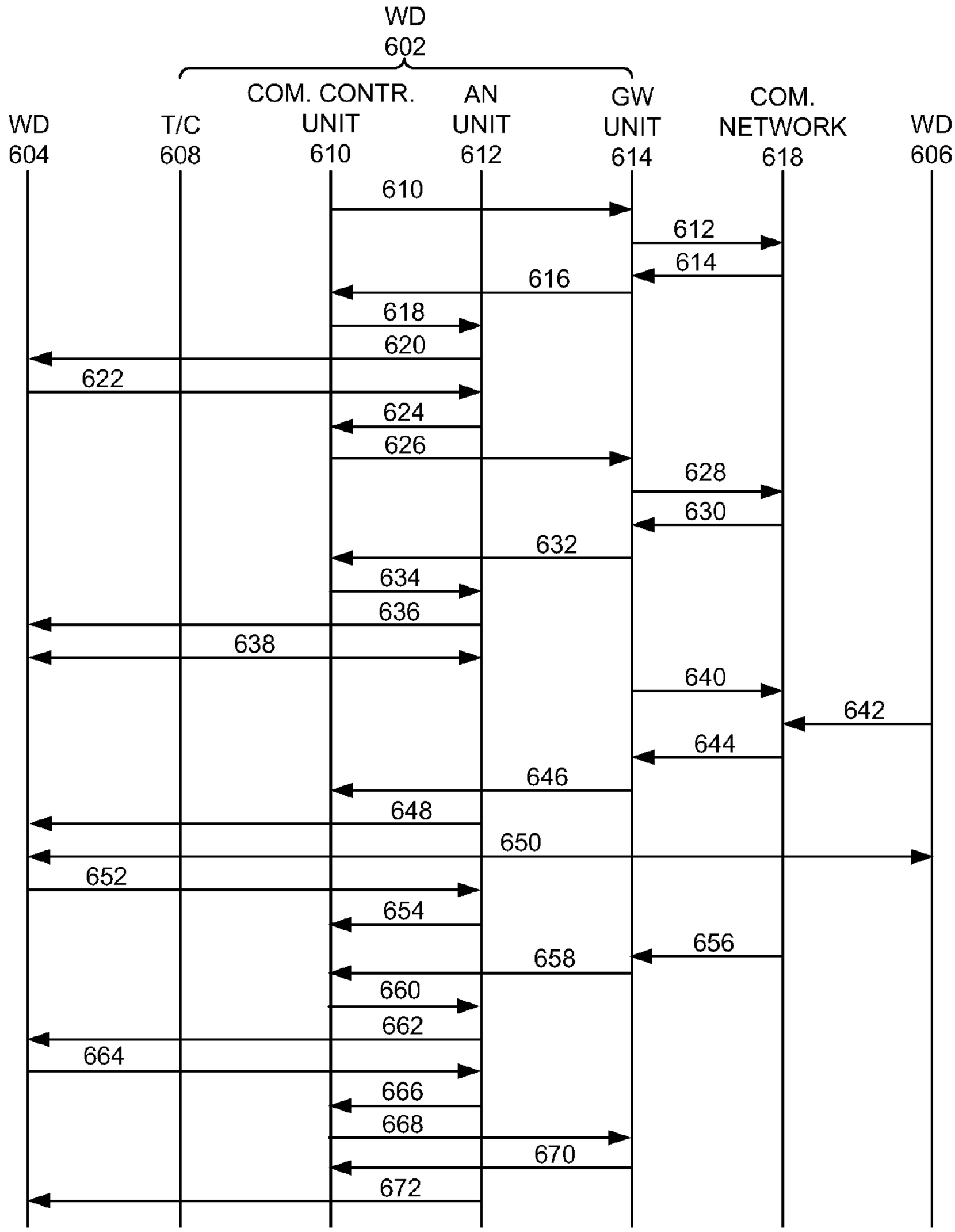
WD
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FIG. 6

PROVIDING WIRELESS NETWORK COMMUNICATION AMONG A PLURALITY OF WIRELESS DEVICES

TECHNICAL BACKGROUND

To communicate over a communication network, a wireless device typically establishes communication with a base station and then initiates one or more communication sessions governed by a controller network element. However, when a large-scale communications network is impaired or disabled, for example, by a natural disaster, wide area network outage, or simply lack of coverage by any base station within range of the wireless device, the wireless device may be unable to establish communication with a base station or with the controller network element to initiate a communication session.

Overview

In systems and methods of providing wireless network communication, it is determined at a first wireless device that a communication link with an access node is not detected, and a communication link is then established between the first wireless device and a communication network using a network communication protocol. An indication that the first wireless device can provide wireless communications to a second wireless device using a cellular radio access technology is then transmitted from the first wireless device. In response to a communication channel request from the second wireless device, the first wireless device grants a communication channel to the second wireless device, and the second wireless device is assigned a network address. A request is received at the first wireless device to establish a communication session for the second wireless device over the communication network, and the communication session is established by the wireless device for the second wireless device over the communication network.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates an exemplary communication system for providing wireless network communication.

FIGS. **2**A and **2**B illustrate an exemplary wireless device for providing wireless network communication.

FIG. **3** illustrates an exemplary method of providing wireless network communication.

FIG. **4** illustrates another exemplary communication system for providing wireless network communication.

FIG. **5** illustrates another exemplary method of providing wireless network communication.

FIG. **6** illustrates an exemplary data flow diagram of providing wireless network communication.

DETAILED DESCRIPTION

FIG. **1** illustrates an exemplary communication system **100** for providing wireless network communication comprising wireless device **102**, wireless device **104**, and communication network **106**. Examples of wireless devices **102** and **104** can comprise a cell phone, a smart phone, a computing platform such as a laptop, palmtop, or tablet, a personal digital assistant, or an internet access device, including combinations thereof. Wireless device **104** can communicate with wireless device **102** over communication link **108**. Wireless device **102** can also communicate with communication network **106** over communication link **110**. Wireless device **102** is also configured to provide communications over communication network **106** to wireless device **104**.

Communication network **106** can be a wired and/or wireless communication network, and can comprise processing nodes, routers, gateways, and physical and/or wireless data links for carrying data among various network elements, including combinations thereof, and can include a local area network, a wide area network, and an internetwork (including the Internet). Communication network **106** can be capable of carrying voice information and other data, for example, to support communications by a wireless device such as wireless devices **102** and **104**. Wireless network protocols may comprise code division multiple access (CDMA) 1xRTT, Global System for Mobile communications (GSM), Universal Mobile Telecommunications System (UMTS), High-Speed Packet Access (HSPA), Evolution Data Optimized (EV-DO), EV-DO rev. A, Worldwide Interoperability for Microwave Access (WiMAX), and Third Generation Partnership Project Long Term Evolution (3GPP LTE). Wired network protocols that may be utilized by communication network **106** comprise Ethernet, Fast Ethernet, Gigabit Ethernet, Local Talk (such as Carrier Sense Multiple Access with Collision Avoidance), Token Ring, Fiber Distributed Data Interface (FDDI), and Asynchronous Transfer Mode (ATM). Communication network **106** may also comprise a wireless network, including base stations, wireless communication nodes, telephony switches, internet routers, network gateways, computer systems, communication links, or some other type of communication equipment, and combinations thereof.

Communication links **108** and **110** can be wired or wireless communication links. Wired communication links can comprise, for example, twisted pair cable, coaxial cable or fiber optic cable, or combinations thereof. Wireless communication links can comprise a radio frequency, microwave, infrared, or other similar signal. In an embodiment, communication link **108** comprises a wireless communication link using one or more cellular radio access technologies and/or protocols, and communication link **110** comprises a wireless communication link using one or more wireless network communication protocols. Examples of a cellular radio access technology or protocol include Global System for Mobile telecommunications (GSM), Code Division Multiple Access (CDMA), Worldwide Interoperability for Microwave Access (WiMAX), Long Term Evolution (LTE), and LTE-Advanced. Other cellular radio access technologies or protocols can also be used, including combinations of the foregoing. Examples of a network communication protocol include the IEEE 802.11 family of protocols, the IEEE 802.15 family of protocols, and the like. Other network communication protocols can also be used, including combinations of the foregoing.

Other network elements may be present in communication system **100** to facilitate wireless communication but are omitted for clarity, such as base stations, base station controllers, gateways, mobile switching centers, dispatch application processors, location registers such as a home location register or visitor location register, additional processing nodes, routers, gateways, and physical and/or wireless data links for carrying data among the various network elements.

In operation, it is determined at wireless device **102** that a communication link with an access node is not detected. For example, wireless device **102** may scan for a signal from an access node, such as a pilot signal, a system information broadcast message, and the like, and may not detect any such signal. Wireless device **102** may then establish communication link **110** with communication network **106** using a network communication protocol.

When communication link **110** is established with communication network **106**, wireless device **102** transmits an

indication wireless device **102** can provide wireless communications to a second wireless device (e.g., wireless device **104**) using a cellular radio access technology. In response to a communication channel request from wireless device **104**, wireless device **102** grants a communication channel to wireless device **104**, and wireless device **102** assigns to wireless device **104** a network address. Subsequently, when a request is received at wireless device **102** to establish a communication session for wireless device **104** over communication network **106**, the communication session is established by wireless device **102** for wireless device **104** over communication network **106**. For example, wireless device **102** can receive a call request from communication network **106** to establish a voice communication session or a data communication session with wireless device **104**, and wireless device **102** can establish the voice or data communication session with wireless device **104**. Similarly, wireless device **102** can receive a call request from wireless device **104** to establish a communication session with a third wireless device over communication network **106**, and wireless device **102** can establish the (voice or data) communication session between wireless device **104** and the third wireless device.

FIG. **2**A illustrates an exemplary wireless device **202** for providing wireless network communication comprising processor **204**, display **206**, display driver **208**, user interface **210**, audio input/output **212**, transceiver **214**, memory **210**, access node unit **218**, communication controller unit **220**, and gateway unit **222**. Display **206** can display information, and can be coupled with user interface **210** to receive input, such as by a touch screen or similar device. Display driver **208** controls the display of information on display **206**. Memory **216** can store data, and can comprise, for example, a disk drive, a flash drive, a solid state memory device, a memory circuitry, or some other memory device, in various forms of volatile and non-volatile memory storage. Memory **216** can store software comprising for example computer programs, firmware, or some other form of machine-readable instructions, and may include an operating system, utilities, drivers, network interfaces, applications, or some other type of software. Memory **216** can further comprise one or more buffers to store data related to wireless communications of a second wireless device. For example, memory **216** can buffer data which arrives from a communication network for the second wireless device, and can further buffer data which arrives from the second wireless device to be transmitted over the communication network.

Transceiver **214** enables wireless device **102** to communicate wirelessly, for example, with another wireless device and/or with a communication network. Wireless signals for example comprise radio frequency, microwave, infrared, laser, visible light, and other similar signals. Audio input and output **212** can comprise a speaker to produce sound and/or a microphone to receive sound input. Processor **204** can retrieve and execute software from the memory **216**, process data, and control the operation of elements **206-222**.

Access node unit **218** comprises a hardware device configured to transmit an indication that the wireless device can provide wireless communications to a second wireless device using a cellular radio access technology, and to grant a communication channel to the second wireless device in response to a communication channel request from the second wireless device. Access node unit **218** can control transmission and reception of signals using transceiver **214**. Access node unit **218** can be configured to transmit system information to enable a second wireless device to perform synchronization, ranging, and random access procedures with wireless device **202**.

Access node unit **218** can further be configured to perform control functions over a communication link with a second wireless device (e.g., wireless device **102** can perform control functions on communication link **108** with wireless device **104**). Such control functions can comprise establishing, modifying, and releasing radio resource connections; establishing, modifying, and releasing dedicated resource bearers to carry bearer traffic; scheduling the delivery of data to a second wireless device and the receipt of data from the second wireless device; assigning and modifying Automatic Repeat Request (ARQ) and/or Hybrid Automatic Repeat Request (HARD) parameters; negotiation and controlling quality of service-related scheduling; and performing inter- and intra-frequency handover. Access node unit **218** can further send a paging message to a second wireless device when a call request or data arrives for the second wireless device. Other access node functions are also possible, including combinations of the foregoing.

Communication controller unit **220** comprises a hardware device configured to establish a communication link between the wireless device and a communication network using a network communication protocol when the communication link with the access node is not detected. Communication controller unit **220** can control the establishment and de-establishment of a bearer channel and a signaling channel with a second wireless device. Communication controller unit **220** can also be configured to store a network location assigned to a second wireless device, to determine when the second wireless device enters an idle mode, and to instruct that a paging message be sent to the second wireless device when the second wireless device is in a lower power mode (e.g., an idle mode) when a call request or data arrives at the wireless device for the second wireless device. Communication controller unit **220** can further communicate with a database through a communication network, such as an authentication node, to authorize a second wireless device for network communication.

Gateway unit **222** comprises a hardware device configured to assign a network address to the second wireless device to enable the second wireless device to communicate over the communication network. Gateway unit **222** can provide connectivity between the second wireless device an communication network (such as communication network **106**) by mediating voice and data traffic between the second wireless device and the communication network. Gateway unit **222** can route and forward data to and from the second wireless device, and can further direct the storage (e.g., buffering) of data received for the second wireless device when the second wireless device is in a lower power or idle state. Gateway unit **222** can also store a group of network addresses to be assigned to the second wireless device. Gateway unit **222** can further manage and store communication session information for the second wireless device, such as context information including parameters of signaling and bearer channels and network routing information. Gateway unit **222** can further be configured to perform policy enforcement, and to perform packet filtering, for the second wireless device.

Access node unit **218**, communication controller unit **220**, and gateway unit **222** can comprise one or more chipsets, printed circuit boards, integrated circuits, or other electronic devices capable of being configured as described above. Elements **204-222** can communicate over communication link **224**, for example a communication bus. Each of the elements **206**, **208**, **210**, **212**, **214** and **216** can be disposed within a housing, but this is by no means a requirement or limitation.

Access node unit **218**, communication controller unit **220**, and gateway unit **222** can comprise functional elements of a

core network architecture of a wireless communication network. For example, access node unit **218**, communication controller unit **220**, and gateway unit **222** can provide some or all of the functional capabilities of a core network such as, for example, an Evolved Packet Core (EPC), a Connectivity Service Network (CSN), a Network Switching Subsystem (NSS), and the like, as well as functional capabilities of access network elements, to functionally extend the coverage and availability of a communication network (such as, e.g., communication network **106**).

FIG. **2**B illustrates an exemplary wireless device **226** for providing wireless network communication comprising processor **228**, display **230**, display driver **232**, user interface **234**, audio input/output **236**, transceiver **238**, and memory **240**. Memory **240** can further comprise access node unit **242**, communication controller unit **244**, and gateway unit **246**. Elements **228-240** can communicate over communication link **248**, for example a communication bus. Each of the elements **228-240** can be disposed within a housing, but this is by no means a requirement or limitation. Elements **228-240** are analogous to elements **204-216** described above with respect to FIG. **2**A.

Access node unit **242**, communication controller unit **244**, and gateway unit **246** can comprise computer-readable codes embodied on a computer-readable recording medium, such as software code, which can be stored in memory **240**. Access node unit **242**, communication controller unit **244**, and gateway unit **246** are functionally analogous to access node unit **218**, communication controller unit **220**, and gateway unit **222**, described above with respect to FIG. **2**A.

Access node unit **242**, communication controller unit **244**, and gateway unit **246** can comprise functional elements of a core network architecture of a wireless communication network. For example, access node unit **242**, communication controller unit **244**, and gateway unit **246** can provide some or all of the functional capabilities of a core network such as, for example, an Evolved Packet Core (EPC), a Connectivity Service Network (CSN), a Network Switching Subsystem (NSS), and the like, as well as functional capabilities of access network elements, to functionally extend the coverage and availability of a communication network (such as, e.g., communication network **106**).

FIG. **3** illustrates an exemplary method of providing wireless network communication. In operation **302**, it is determined at a first wireless device that a communication link with an access node is not detected. For example, wireless device **102** may scan for a signal from an access node, such as a pilot signal, a system information broadcast message, and the like, and may not detect any such signal from an access node. The wireless device may scan for a signal which uses a cellular communication protocol.

The first wireless device then establishes a communication link with a communication network using a network communication protocol (operation **304**). For example, wireless device **102** can establish communication link **110** with communication network **106**. In an embodiment, communication link **110** can be established at the instruction of communication controller unit **220** through gateway unit **222**, so that information to or from communication network **106** passes through gateway unit **222**. In an embodiment, communication link **110** can be established at the instruction of communication controller unit **244** so that information to or from communication network **106** is received and processed at the direction of gateway unit **246**.

When the communication link is established between the first wireless device and the communication network, the first wireless device transmits an indication that it can provide wireless communications to a second wireless device using a cellular radio access technology (operation **306**). For example, when communication link **110** is established with communication network **106**, wireless device **102** transmits an indication wireless device **102** can provide wireless communications to a second wireless device (e.g., wireless device **104**) using a cellular radio access technology. The indication can be transmitted at the instruction of, for example, access node unit **218** or access node unit **242**. The indication can comprise an access node unit identifier (such as a base station ID, an eNodeB ID, and the like), a pilot signal, a system information block message (for example, a MIB, SIB or other information message), synchronization information, ranging information, or another indication which can be received at a second wireless device and which informs the second wireless device that the first wireless device can provide wireless communications to the second wireless device.

The first wireless device may then receive a request for a communication channel from the second wireless device (operation **308**), and in response to the communication channel request, the first wireless device may grant a communication channel to the second wireless device (operation **310**). For example, in response to a communication channel request from wireless device **104**, wireless device **102** can grant a communication channel to wireless device **104**. In an embodiment, wireless device **102** and wireless device **104** can engage in a synchronization process, a ranging process, and a random access process to grant the communication channel to wireless device **104**. For example, wireless device **104** can acquire the indication that wireless device **102** is able to provide wireless communications to wireless device **104**, and the indication can comprise synchronization information, such as time slot information, frame synchronization information, a primary synchronization signal, a secondary synchronization signal, and the like, to perform synchronization with wireless device **102**. When synchronization is performed, wireless device **102** can communicate additional information to wireless device **104**, including system information such as, for example, a master information block, one or more system information blocks, and the like, which can comprise a network identifier (e.g., a PLMN ID), a tracking area identifier (which can be used to send a paging message to wireless device **104**), an access node unit identifier (to identify access node unit **218** or **242**), a root sequence indicator and/or cyclic shift indicator, information about available frequency bands over which to communicate with wireless device **102**, and the like. Wireless device **104** can further acquire ranging information from wireless device **102**, and the wireless devices can perform a ranging operation to determine an appropriate transmit power and other signal parameters for wireless device **104** to communicate with wireless device **102**. In an embodiment, a transmit power for wireless device **102** can also be determined using the ranging process with wireless device **104**.

When synchronization is complete, wireless devices **102** and **104** can perform a random access procedure to grant the communication channel to wireless device **104**. For example, wireless device **104** can select a random access (RACH) preamble and can transmit a request for a communication channel using the random access preamble. Where wireless device **102** provides wireless communications to two or more other wireless devices, the RACH preamble can serve to distinguish the communication channel request from wireless device **104** from communications from other wireless devices. Wireless device **104** can determine one or more

RACH preambles from the root sequence indicator and/or cyclic shift indicator previously acquired from wireless device **102**.

When the communication channel is granted to the second wireless device, the first wireless device assigns a network address to the second wireless device (operation **312**). When the communication channel is granted to wireless device **104**, a network address is assigned to wireless device **104** to route data to wireless device **104**. For example, gateway unit **222** or gateway unit **246** can comprise a pool of network addresses (for example, internet protocol (IP) addresses or similar network location identifiers) to enable the routing of data to wireless device **104** by wireless device **102**. Gateway unit **222** or gateway unit **246** can assign the network address to the second wireless device, and can use the assigned network address to route data communications between wireless device **104** and communication network **106**.

In operation **314**, a communication session request is received to establish a communication session with the second wireless device. For example, wireless device **102** can receive a call request to establish a voice communication session with wireless device **104**. The call request can originate from a third wireless device to establish the communication session with wireless device **104**, or the call request can originate from wireless device **104** to establish the communication session with the third wireless device. The communication session request can further comprise a data communication session request, which can originate from either wireless device **104**, or from a third wireless device. The communication session request can be received at access node unit **218** or **242** (through transceiver **214** or **238**), and can be passed to communication control unit **220** or **244**.

Communication control unit **220** or **244** can then instruct the establishment of the communication session for wireless device **104** (operation **316**). Communications sent by wireless device **104** can be received at wireless device **102** by access node unit **218** or **242** through transceiver **214** or **238**, and the received communications can be transferred by gateway unit **222** or **246** to communication network **106** using transceiver **214** or **238**. Communications sent by the third wireless device can be received at gateway unit **222** or **246** from communication network **106** using transceiver **214** or **238**, and can be sent to wireless device **104** by access node unit **218** or **242** through transceiver **214** or **238**.

FIG. **4** illustrates another exemplary communication system for providing wireless network communication comprising wireless devices **402**, **404** and **406**, communication network **408**, authentication node **410** and content node or application node (C/A node) **412**. Examples of wireless devices **402**, **404** and **406** can comprise a cell phone, a smart phone, a computing platform such as a laptop, palmtop, or tablet, a personal digital assistant, or an internet access device, including combinations thereof. Wireless device **404** can communicate with wireless device **402** over communication link **416**. Wireless device **402** can also communicate with communication network **408** over communication link **414**. Wireless device **406** can communicate with communication network **406** over communication link **418**. Wireless device **402** is also configured to provide communications over communication network **408** to wireless device **404**.

Authentication node **410** can comprise a processor and associated circuitry to execute or direct the execution of computer-readable instructions, and can be configured to maintain and provide authorization, authentication, and accounting information related to communication sessions and network access for wireless deivces **402**, **404** and **406**. Authentication node **410** can retrieve and execute software from storage, which can include a disk drive, flash drive, memory circuitry, or some other memory device, and which can be local or remotely accessible. The software comprises computer programs, firmware, or some other form of machine-readable instructions, and may include an operating system, utilities, drivers, network interfaces, applications, or some other type of software, including combinations thereof. Authentication node **410** can receive instructions and other input at a user interface. Examples of authentication node **410** can include a standalone computing device, a computer system, or a network component, such as an access service network gateway (ASN-GW), a packet data network gateway (P-GW), a serving gateway (S-GW), a subscriber profile system (SPS), authentication, authorization, and accounting (AAA) equipment, and the like, including combinations thereof. Authentication node **410** is in communication with communication network **408** over communication link **420**.

Content node/application (C/A) node **412** can comprise a processor and associated circuitry to execute or direct the execution of computer-readable instructions, and can be configured to provide content or a service to a wireless device over communication network **408**. Content can comprise audio, video, multimedia, or some other form of content, which may be digitally encoded or electronically encoded for transmission over communication network **408**. An application provided by network node **412** can comprise an application, an information processing service, an information retrieval service, an information lookup service, or some other information provision or information processing which may be provided to a wireless device over communication network **408**. C/A node **412** can retrieve and execute software from storage, which can include a disk drive, flash drive, memory circuitry, or some other memory device, and which can be local or remotely accessible. The software comprises computer programs, firmware, or some other form of machine-readable instructions, and may include an operating system, utilities, drivers, network interfaces, applications, or some other type of software, including combinations thereof. C/A node **412** can receive instructions and other input at a user interface. Examples of C/A node **412** can include a standalone computing device, a computer system, or a network component, such as an access service network gateway (ASN-GW), a packet data network gateway (P-GW), a serving gateway (S-GW), a packet data serving node (PDSN), an IP Multimedia Subsystem (IMS), a network server mediated by an IMS, and the like, including combinations thereof. C/A node **412** is in communication with communication network **480** over communication link **422**.

Communication network **408** can be a wired and/or wireless communication network, and can comprise processing nodes, routers, gateways, and physical and/or wireless data links for carrying data among various network elements, including combinations thereof, and can include a local area network, a wide area network, and an internetwork (including the Internet). Communication network **408** can be capable of carrying voice information and other data, for example, to support communications by a wireless device such as wireless devices **402**, **404** and **406**. Wireless network protocols may comprise code division multiple access (CDMA) 1xRTT, Global System for Mobile communications (GSM), Universal Mobile Telecommunications System (UMTS), High-Speed Packet Access (HSPA), Evolution Data Optimized (EV-DO), EV-DO rev. A, Worldwide Interoperability for Microwave Access (WiMAX), and Third Generation Partnership Project Long Term Evolution (3GPP LTE). Wired network protocols that may be utilized by communication network **408** comprise Ethernet, Fast Ethernet, Gigabit Eth-

ernet, Local Talk (such as Carrier Sense Multiple Access with Collision Avoidance), Token Ring, Fiber Distributed Data Interface (FDDI), and Asynchronous Transfer Mode (ATM). Communication network **408** may also comprise a wireless network, including base stations, wireless communication nodes, telephony switches, internet routers, network gateways, computer systems, communication links, or some other type of communication equipment, and combinations thereof.

Communication links **414**, **416**, **418**, **420** and **422** can be wired or wireless communication links. Wired communication links can comprise, for example, twisted pair cable, coaxial cable or fiber optic cable, or combinations thereof. Wireless communication links can comprise a radio frequency, microwave, infrared, or other similar signal. In an embodiment, communication links **416** and **418** each comprise a wireless communication link using one or more cellular radio access technologies and/or protocols, and communication link **414** comprises a wireless communication link using one or more wireless network communication protocols. Examples of a cellular radio access technology or protocol include Global System for Mobile telecommunications (GSM), Code Division Multiple Access (CDMA), Worldwide Interoperability for Microwave Access (WiMAX), Long Term Evolution (LTE), and LTE-Advanced. Other cellular radio access technologies or protocols can also be used, including combinations of the foregoing. Examples of a network communication protocol include the IEEE 802.11 family of protocols, the IEEE 802.15 family of protocols, and the like. Other network communication protocols can also be used, including combinations of the foregoing.

In an embodiment, communication link **416** comprises a wireless communication link using one or more cellular radio access technologies and/or protocols, and communication link **414** comprises a wireless communication link using one or more network communication protocols.

Other network elements may be present in communication system **400** to facilitate wireless communication but are omitted for clarity, such as base stations, base station controllers, gateways, mobile switching centers, dispatch application processors, location registers such as a home location register or visitor location register, additional processing nodes, routers, gateways, and physical and/or wireless data links for carrying data among the various network elements. Furthermore, other network elements may be present to facilitate communication among communication network **408**, authentication node **410** and C/A node **412** which are omitted for clarity, including additional processing nodes, routers, gateways, and physical and/or wireless data links for carrying data among the various network elements.

FIG. **5** illustrates another exemplary method of providing wireless network communication. In operation **502**, it is determined at a first wireless device that a communication link with an access node is not detected. For example, wireless device **402** may scan for a signal from an access node, such as a pilot signal, a system information broadcast message, and the like, and may not detect any such signal from an access node. The first wireless device then establishes a communication link with a communication network using a network communication protocol (operation **504**). For example, wireless device **402** can establish communication link **414** with communication network **408**. In an embodiment, communication link **414** can be established at the instruction of a communication controller unit of the wireless device (e.g., communication controller unit **220** or **244**) through a gateway unit of the wireless device (e.g., gateway unit **222** or **246**), so that information to or from communication network **408** passes through the gateway unit.

When the communication link is established between the first wireless device and the communication network, the first wireless device transmits an indication that it can provide wireless communications to a second wireless device using a cellular radio access technology (operation **506**). For example, when communication link **110** is established with communication network **106**, wireless device **102** transmits an indication wireless device **102** can provide wireless communications to a second wireless device (e.g., wireless device **104**) using a cellular radio access technology. The indication can be transmitted at the instruction of, for example, access node unit **218** or access node unit **242**. The indication can comprise an access node unit identifier (such as a base station ID, an eNodeB ID, and the like), a pilot signal, a system information block message (for example, a MIB, SIB or other information message), synchronization information, ranging information, or another indication which can be received at a second wireless device and which informs the second wireless device that the first wireless device can provide wireless communications to the second wireless device.

The first wireless device may then receive a request for a communication channel from the second wireless device (operation **508**), and in response to the communication channel request, the first wireless device may perform admission control functions (operation **510**). For example, wireless device **402** can receive a request for a communication channel from wireless device **404**. In an embodiment, wireless devices **402** and **404** can engage in a synchronization process, a ranging process, and a random access process. From information sent by wireless device **402** (e.g., in the indication that wireless device **402** is able to provide wireless communications) wireless device **404** can acquire synchronization information, such as time slot information, frame synchronization information, a primary synchronization signal, a secondary synchronization signal, and the like, to perform synchronization with wireless device **402**. When synchronization is performed, wireless device **404** can acquire additional information from wireless device **402**, including system information such as, for example, a master information block, one or more system information blocks, and the like, which can comprise a network identifier (e.g., a PLMN ID), a tracking area identifier (which can be used to send a paging message to wireless device **404**), an access node unit identifier (to identify access node unit **218** or **242**), a root sequence indicator and/or cyclic shift indicator, information about available frequency bands over which to communicate with wireless device **402**, and the like. Wireless device **404** can further acquire ranging information from wireless device **402**, and the wireless devices can perform a ranging operation to determine an appropriate transmit power and other signal parameters for wireless device **404** to communicate with wireless device **402**. In an embodiment, a transmit power for wireless device **402** can also be determined using the ranging process with wireless device **404**. Wireless device **404** can select a random access (RACH) preamble and can transmit a request for a communication channel using the random access preamble. Where wireless device **402** provides wireless communications to two or more other wireless devices, the RACH preamble can serve to distinguish the communication channel request from wireless device **404** from communications from other wireless devices. Wireless device **404** can determine one or more RACH preambles from the root sequence indicator and/or cyclic shift indicator previously acquired from wireless device **402**.

The request for a communication channel can further comprise identification information of wireless device **404**, such as an IMEI or other wireless device identifier, account information associating wireless device **404** with a particular subscriber account, and the like. The request for a communication channel can also comprise one or more security credentials for wireless device **404**. Wireless device **402** can receive the identification information and/or the security credentials of wireless device **404** and can further transmit the received identification information and/or the security credentials to authentication node **410** (operation **512**). The identification information and/or the security credentials of wireless device **404** can be received at access node unit **218** or **242**, which can provide the identification information and/or the security credentials to communication controller unit **220** or **244**. Communication controller unit **220** or **244** can then instruct gateway unit **222** or **246** to transmit the identification information and/or the security credentials to authentication node **410** with a request to authenticate wireless device **404** for access to communication network **408**.

Authentication node **410** can respond that wireless device is authenticated to communicate over communication network **408**, which response can be received at gateway unit **222** or **246** and provided to communication controller unit **222** or **244**. Communication controller unit **222** or **244** can instruct access node unit **218** or **242** to provide an indication to wireless device **404** that wireless device **404** is authorized to communicate over communicate network **408**, and communication controller unit **222** can further grant a communication channel to wireless device **404** (operation **514**). In an embodiment, when the communication channel is granted to wireless device **404**, communication controller unit **222** or **244** can instruct access node unit **218** or **242** and/or gateway unit **222** or **246** to reserve resources for wireless device **404**. The resources can comprise memory space, processor time, reserving wireless resources on communication link **416** for communication to or from wireless device **404**, reserving resources of communication link **414** to communicate information with communication network **408** related to communications of wireless device **404**, and the like.

When the channel is granted to the second wireless device, the first and second wireless devices can negotiate a quality of service to be provided to the second wireless device (operation **516**). For example, access node unit **218** or **242** can comprise a scheduling unit to schedule the delivery of data to wireless device **404** over communication link **416**. Based on information from wireless device **404**, access node unit **218** or **242** can determine an application requirement of an application running on wireless device **404**. The application requirement can comprise a minimum data rate, a maximum permitted data delay, a minimum throughput, a maximum error rate, a maximum data loss rate, and the like, of an application running on a wireless device. The application requirement can also be determined based on the application type, such as whether the application is a relatively delay sensitive application (such as a streaming audio application a streaming video application, a voice application, and the like) or a relatively delay insensitive application (such as an email application, a messaging application, a web browsing application, and the like).

Based on the application requirement, access node unit **218** or **242** can determine a quality of service to be provided to wireless device **404** to meet the application requirement. Additionally, or alternatively, based on information from authentication node **410**, access node unit **218** or **242** can determine a priority to apply to information to or from wireless device **404**, and based on the priority access node unit **218** or **242** can schedule data to be delivered to and/or received from wireless device **404** relative to the scheduling of data to or from other wireless devices. For example, where authentication node **410** provides an indication that wireless device **404** is associated with a higher priority (e.g., because wireless device **404** is associated with an emergency responder account, a premium customer account, and the like), data to and/or from wireless device **404** can be scheduled before data to or from lower priority wireless devices.

The granting of the communication channel to wireless device **404** can further comprise negotiating wireless communication link parameters, such as selection of one or more frequency bands for communication between wireless devices **402** and **404**, a modulation and coding scheme to be assigned to communication link **416**, and the like.

Next, the first wireless device assigns a network address to the second wireless device (operation **518**). For example, when the communication channel is granted to wireless device **404**, a network address is assigned to wireless device **404** to route data to wireless device **404**. For example, gateway unit **222** or gateway unit **246** can comprise a pool of network addresses (for example, internet protocol (IP) addresses or similar network location identifiers) to enable the routing of data to wireless device **404** by wireless device **402**. Gateway unit **222** or gateway unit **246** can assign the network address to the second wireless device, and can use the assigned network address to route data communications between wireless device **404** and communication network **408**. When then network address is assigned to wireless device **404**, wireless device **402** can advertise or present the assigned network address to communication network **408** to permit data to be addressed to and routed to wireless device **404** (operation **520**). Using the network address for wireless device **404** which is presented by wireless device **402**, another wireless device (e.g., wireless device **406**) can address data to wireless device **404**, and the addressed data can be routed to wireless device **404** using the assigned network address through wireless device **402**.

In operation **522**, a communication session request is received to establish a communication session with the second wireless device. For example, wireless device **402** can receive a call request to establish a voice communication session with wireless device **404**. The call request can originate from a third wireless device, such as wireless device **406**, to establish the communication session with wireless device **404**, or the call request can originate from wireless device **404** to establish the communication session with the third wireless device. The communication session request can further comprise a data communication session request, which can originate from either wireless device **404** or from wireless device **406**. When the communication session request originates from wireless device **404**, the request can be received at access node unit **218** or **242** (through transceiver **214** or **238**), and can be passed to communication control unit **220** or **244**. When the communication session request originates from wireless device **406**, the request can be received at gateway unit **222** or **246** (through transceiver **214** or **238**), and can be passed to communication control unit **220** or **244**.

Communication control unit **220** or **244** can then instruct the establishment of the communication session for wireless device **404** (operation **524**). Communications sent by wireless device **404** can be received at wireless device **402** by access node unit **218** or **242** through transceiver **214** or **238**, and the received communications can be transferred by gateway unit **222** or **246** to communication network **106** using transceiver **214** or **238**. Communications sent by wireless device **406** can be received at gateway unit **222** or **246** and can

be transferred to access node unit **218** or **242** for transmission to wireless device **404** (using transceiver **214** or **238**).

The communication session request from wireless device **404** can also comprise a request for data from C/A node **412**. Access node unit **218** or **242** can receive the communication session request and can transfer the communication session request to gateway unit **222** or **246**. Gateway unit **222** or **246** can address the request for data to C/A node **412** based on information in the request from wireless device **404**, such as a content identifier, a network address identifier of C/A node **412**, and the like. Data received from C/A node **412** for wireless device **404** can be received at gateway unit **222** or **246** and can be transferred to access node unit **218** or **242** for transmission to wireless device **404** (using transceiver **214** or **238**).

Wireless device **404** can also enter a lower power state, such as an idle state, a sleep state, and the like. When wireless device **404** enters the lower power state, wireless device **404** can send an indication to wireless device **402**, and wireless device **402** can store a network location for wireless device **404** (operation **526**). The stored network location can be used by wireless device **402** when, for example, data or a call request arrives at wireless device **402** for delivery to wireless device **404**. As an example, data can be received at gateway unit **222** or **246** from communication network **408** for wireless device **404**. Gateway unit **222** or **246** can send a message to communication control unit **220** or **244** to notify communication control unit **220** or **244** that the data has been received for wireless device **404**. Communication control unit **220** or **244** can then instruct access node unit **218** or **242** to send a paging message to wireless device **404** (operation **528**). The paging message can inform wireless device **404** that data is awaiting delivery to wireless device **404**. In response to the paging message, wireless device **404** can leave the lower power state and can send a request for a communication channel to wireless device **402**, which can be received by access node unit **218** or **242**. Access node unit **218** or **242** can send a message to communication control unit **220** or **244**, and communication control unit **220** or **244** can grant the communication channel to wireless device **404**. When the communication channel is granted, communication control unit **220** or **244** can instruct gateway unit **222** or **246** to provide the data to access node unit **218** or **242** to be sent to wireless device **404** from wireless device **402**. Additionally, or alternatively, the data for wireless device **404** can be received at gateway unit **222** or **246** and can be transferred to and stored by (or at the instruction of) access node unit **218** or **242** before the communication channel is granted to wireless device **404**. Then, when the communication channel is granted to wireless device **404**, the data can be sent to wireless device **404** from access node unit **218** or **242**.

FIG. **6** illustrates an exemplary data flow diagram of providing wireless network communication. Wireless device **602** may scan for a signal from an access node, such as a pilot signal, a system information broadcast message, and the like, and when such a signal is not detected from an access node, wireless device **602** may determine that an access node is not detected. Wireless device may then establish a communication link with a communication network using a network communication protocol. Communication controller **610** instructs gateway unit **614** (**610**) to send a message (**612**) to communication network **618** to establish a communication link with communication network **618**. Communication network **618** responds (**614**) with information confirming the establishment of the communication link between wireless device **602** and communication network **618**, and gateway unit **614** provides information (**616**) about the communication link to communication controller unit **610**.

When the communication link is established between wireless device **602** and communication network **618**, the wireless device **602** transmits an indication that it can provide wireless communications to a second wireless device (wireless device **604**) using a cellular radio access technology (**620**). Communication controller unit **610** can instruct (**618**) access node unit **612** to transmit the indication (**620**). The indication can comprise an access node unit identifier (such as a base station ID, an eNodeB ID, and the like), a pilot signal, a system information block message (for example, a MIB, SIB or other information message), synchronization information, ranging information, or another indication which can be received at a second wireless device and which informs the second wireless device that the first wireless device can provide wireless communications to the second wireless device.

Wireless device **602** may then receive a request for a communication channel from wireless device **604** (**622**), and in response to the communication channel request, wireless device **602** may perform admission control functions. In an embodiment, wireless devices **602** and **604** can engage in a synchronization process, a ranging process, and a random access process. From information sent by wireless device **602** (e.g., in indication **620** that wireless device **602** is able to provide wireless communications) wireless device **604** can acquire synchronization information, such as time slot information, frame synchronization information, a primary synchronization signal, a secondary synchronization signal, and the like, to perform synchronization with wireless device **602**. When synchronization is performed, wireless device **604** can acquire additional information from wireless device **602**, including system information such as, for example, a master information block, one or more system information blocks, and the like, which can comprise a network identifier (e.g., a PLMN ID), a tracking area identifier (which can be used to send a paging message to wireless device **604**), an access node unit identifier (to identify access node unit **612**), a root sequence indicator and/or cyclic shift indicator, information about available frequency bands over which to communicate with wireless device **602**, and the like. Wireless device **604** can further acquire ranging information from wireless device **602**, and the wireless devices can perform a ranging operation to determine an appropriate transmit power and other signal parameters for wireless device **604** to communicate with wireless device **602**. In an embodiment, a transmit power for wireless device **602** can also be determined using the ranging process with wireless device **604**. Wireless device **604** can select a random access (RACH) preamble and can transmit a request for a communication channel using the random access preamble. Where wireless device **602** provides wireless communications to two or more other wireless devices, the RACH preamble can serve to distinguish the communication channel request from wireless device **604** from communications from other wireless devices. Wireless device **604** can determine one or more RACH preambles from the root sequence indicator and/or cyclic shift indicator previously acquired from wireless device **602**.

The request for a communication channel (**622**) can further comprise identification information of wireless device **604**, such as an IMEI or other wireless device identifier, account information associating wireless device **604** with a particular subscriber account, and the like. The request for a communication channel can also comprise one or more security credentials for wireless device **604**. Wireless device **602** can receive the identification information and/or the security credentials of wireless device **604** at access node unit **612**, which

can notify communication controller unit **610** (**624**). Access node unit **612** can provide the identification information and/or the security credentials of wireless device **604** to gateway unit **614** (either by its own instruction or at the instruction of communication controller unit **610**) (**626**), and gateway unit **614** can further transmit the received identification information and/or the security credentials to communication network **618** (**628**) for provision to an authentication node (not illustrated). Gateway unit **614** can receive a response (**620**) from the authentication node over communication network **618** indicating that wireless device **604** is authenticated to communicate over communication network **618**, and the response can be provided to communication controller unit **610** (**632**). Communication controller unit **610** can then instruct (**634**) access node unit **612** to provide an indication (**636**) to wireless device **604** that wireless device **604** is authorized to communicate over communicate network **618**, and that communication controller unit **610** has granted a communication channel to wireless device **604**.

In an embodiment, when the communication channel is granted to wireless device **604**, communication controller unit **610** can instruct access node unit **612** and/or gateway unit **614** to reserve resources for wireless device **604**. The resources can comprise memory space, processor time, reserving wireless resources on a communication link between wireless device **602** and wireless device **604**, reserving resources of a communication link between wireless device **602** and communication network **618** related to communications of wireless device **604**, and the like.

When the channel is granted to wireless device **604**, the wireless devices **602** and **604** can negotiate a quality of service to be provided to the wireless device **604** (**638**). For example, access node unit **612** can comprise a scheduling unit to schedule the delivery of data to wireless device **604**. Based on information from wireless device **604**, access node unit **612** can determine an application requirement of an application running on wireless device **604**. The application requirement can comprise a minimum data rate, a maximum permitted data delay, a minimum throughput, a maximum error rate, a maximum data loss rate, and the like, of an application running on a wireless device. The application requirement can also be determined based on the application type, such as whether the application is a relatively delay sensitive application (such as a streaming audio application a streaming video application, a voice application, and the like) or a relatively delay insensitive application (such as an email application, a messaging application, a web browsing application, and the like). Based on the application requirement, access node unit **612** can determine a quality of service to be provided to wireless device **604** to meet the application requirement. Additionally, or alternatively, based on information from the authentication node, access node unit **612** can determine a priority to apply to information to or from wireless device **604**, and based on the priority access node unit **612** can schedule data to be delivered to and/or received from wireless device **604** relative to the scheduling of data to or from other wireless devices. For example, where the authentication node provides an indication that wireless device **604** is associated with a higher priority (e.g., because wireless device **604** is associated with an emergency responder account, a premium customer account, and the like), data to and/or from wireless device **604** can be scheduled before data to or from lower priority wireless devices.

Next, wireless device **602** assigns a network address to wireless device **604** to route data to wireless device **604**. Gateway unit **614** can comprise a pool of network addresses (for example, internet protocol (IP) addresses or similar network location identifiers) to enable the routing of data to wireless device **604** by wireless device **602**. Gateway unit **614** can assign the network address to wireless device **604**, and can use the assigned network address to route data communications between wireless device **604** and communication network **618**. When then network address is assigned to wireless device **604**, gateway unit **614** can advertise or present the assigned network address to communication network **618** (**640**) to permit data to be addressed to and routed to wireless device **604**. Using the network address for wireless device **604** which is presented by wireless device **602**, another wireless device (e.g., wireless device **606**) can address data to wireless device **604**, and the addressed data can be routed to wireless device **604** using the assigned network address through wireless device **602**.

A communication session request (**642**) can be received at gateway node **614** from communication network **618** (**644**) to establish a communication session with wireless device **604**. The communication session request can further comprise a data communication session request. The communication session request originating from wireless device **606** can be received at gateway unit **614**, and can be passed to communication control unit **610** (**646**). Alternatively, a call request can originate from wireless device **604** to establish the communication session with wireless device **606**, in which case the call request can be received at access node unit **612** and provided to gateway unit **614** for transmission to wireless device **606** over communication network **618**. When the communication session request originates from wireless device **604**, the request can be received at access node unit **612** and can be passed to communication control unit **610**.

Access node unit **612** can then send a notification of the communication session request (**648**) to wireless device **604**. When wireless device **604** accepts the call request, communication control unit **610** can then instruct the establishment of the communication session between wireless devices **604** and **606** (**650**). Communications sent by wireless device **604** can be received at wireless device **602** by access node unit **612**, and the received communications can be transferred by gateway unit **614** to communication network **618**. Communications sent by wireless device **606** can be received at gateway unit **614** from communication network **618** and can be transferred to access node unit **612** for transmission to wireless device **604**.

In an embodiment, a communication session request from wireless device **604** can also comprise a request for data from a C/A node. Access node unit **612** can receive the communication session request and can transfer the communication session request to gateway unit **614**. Gateway unit **614** can address the request for data to a C/A node based on information in the request from wireless device **604**, such as a content identifier, a network address identifier of the C/A node, and the like. Data received from the C/A node for wireless device **604** can be received at gateway unit **614** and can be transferred to access node unit **612** for transmission to wireless device **604**.

Wireless device **604** can also enter a lower power state, such as an idle state, a sleep state, and the like. When wireless device **604** enters the lower power state, wireless device **604** can send an indication (**652**) to wireless device **602** which is received at access node unit **612** and provided (**654**) to communication controller unit **610**. Communication controller unit **610** can then store a network location for wireless device **604**. The stored network location can be used by wireless device **602** when, for example, data or a call request (**656**) arrives at gateway unit **614** from communication network **618** for wireless device **604**. Gateway unit **614** can notify (**658**)

communication control unit **610** that the data has been received for wireless device **604**, and communication control unit **610** can then instruct (**660**) access node unit **612** to send a paging message to wireless device **604** (**662**). The paging message can inform wireless device **604** that data is awaiting delivery to wireless device **604**.

In response to the paging message, wireless device **604** can leave the lower power state and can send a request (**664**) for a communication channel to wireless device **602**, which can be received by access node unit **612**. Access node unit **612** can send a message (**666**) to communication control unit **610**, and communication control unit **610** can grant the communication channel to wireless device **604**. When the communication channel is granted, communication control unit **610** can instruct gateway unit **614** (**668**) to provide (**670**) the data to access node unit **612** to be sent to wireless device **604** (**672**) from wireless device **602**. Additionally, or alternatively, the data for wireless device **604** can be received at gateway unit **614** and can be transferred to and stored by access node unit **612** before the communication channel is granted to wireless device **604**. Then, when the communication channel is granted to wireless device **604**, the data can be sent to wireless device **604** from access node unit **612**.

The exemplary systems and methods described herein can be performed under the control of a processing system executing computer-readable codes embodied on a computer-readable recording medium or communication signals transmitted through a transitory medium. The computer-readable recording medium is any data storage device that can store data readable by a processing system, and includes both volatile and nonvolatile media, removable and non-removable media, and contemplates media readable by a database, a computer, and various other network devices.

Examples of the computer-readable recording medium include, but are not limited to, read-only memory (ROM), random-access memory (RAM), erasable electrically programmable ROM (EEPROM), flash memory or other memory technology, holographic media or other optical disc storage, magnetic storage including magnetic tape and magnetic disk, and solid state storage devices. The computer-readable recording medium can also be distributed over network-coupled computer systems so that the computer-readable code is stored and executed in a distributed fashion. The communication signals transmitted through a transitory medium may include, for example, modulated signals transmitted through wired or wireless transmission paths.

The above description and associated figures teach the best mode of the invention. The following claims specify the scope of the invention. Note that some aspects of the best mode may not fall within the scope of the invention as specified by the claims. Those skilled in the art will appreciate that the features described above can be combined in various ways to form multiple variations of the invention, and that various modifications may be made to the configuration and methodology of the exemplary embodiments disclosed herein without departing from the scope of the present teachings. Those skilled in the art also will appreciate that various features disclosed with respect to one exemplary embodiment herein may be used in combination with other exemplary embodiments with appropriate modifications, even if such combinations are not explicitly disclosed herein. As a result, the invention is not limited to the specific embodiments described above, but only by the following claims and their equivalents.

What is claimed is:

1. A system for providing wireless network communication, comprising:

a wireless device, further comprising

a processor configured to determine that a communication link with an access node is not detected;

a communication controller unit, configured to establish a communication link between the wireless device and a communication network using a network communication protocol when the communication link with the access node is not detected;

an access node unit, configured to transmit an indication that the wireless device can provide wireless communications to a second wireless device using a cellular radio access technology, and to grant a communication channel to the second wireless device in response to a communication channel request from the second wireless device, wherein the access node unit is further configured to schedule data for delivery to the second wireless device based on a traffic class indicator associated with the data; and

a gateway unit, configured to assign a network address to the second wireless device to enable the second wireless device to communicate over the communication network.

2. The system of claim **1**, wherein the access node unit is further configured to perform an admission control function in response to the communication channel request from the second wireless device.

3. The system of claim **1**, wherein the communication controller unit is further configured to authenticate the second wireless device with an authentication node of the communication network.

4. The system of claim **1**, wherein the gateway unit is further configured to assign a network address to the second wireless device out of a pool of network addresses stored at the gateway unit.

5. The system of claim **1**, wherein the gateway unit is further configured to present the assigned network address to the communication network to route data to enable data routing to the second wireless device.

6. The system of claim **1**, wherein the access node unit is further configured to negotiate a quality of service with the authentication node for the second wireless device.

7. The system of claim **1**, wherein the communication controller unit is further configured to store a network location for the second wireless device when the second wireless device enters a lower power state.

8. The system of claim **7**, wherein the communication controller unit is further configured to instruct the access node unit to send a paging message to the second wireless device when data arrives at the first wireless device for the second wireless device.

9. A method of providing wireless network communication, comprising:

determining at a first wireless device that a communication link with an access node is not detected;

establishing a communication link between the first wireless device and a communication network using a network communication protocol;

transmitting from the first wireless device an indication that the first wireless device can provide wireless communications to a second wireless device using a cellular radio access technology;

granting by the first wireless device a communication channel to the second wireless device in response to a communication channel request from the second wireless device;

assigning a network address to the second wireless device;

receiving a request at the first wireless device to establish a communication session for the second wireless device over the communication network;

establishing the communication session by the wireless device for the second wireless device over the communication network; and

scheduling data for delivery to the second wireless device based on a traffic class indicator associated with the data.

10. The method of claim **9**, further comprising performing an admission control function by the first wireless device in response to the communication channel request from the second wireless device.

11. The method of claim **9**, further comprising authenticating the second wireless device by the first wireless device with an authentication node of the communication network.

12. The method of claim **9**, further comprising negotiating a quality of service with the authentication node for the second wireless device.

13. The method of claim **9**, wherein assigning a network address further comprises registering the second wireless device to enable the second wireless device to communicate over the communication network.

14. The method of claim **9**, further comprising presenting the assigned network address by the first wireless device to the communication network to route data to enable data routing to the second wireless device.

15. The method of claim **9**, further comprising storing at the first wireless device a network location for the second wireless device when the second wireless device enters a lower power state.

16. The method of claim **15**, further comprising sending a paging message from the first wireless device to the second wireless device when data arrives at the first wireless device for the second wireless device.

17. A system for providing wireless network communication, comprising:

a wireless device, further comprising

a processor configured to determine that a communication link with an access node is not detected;

a communication controller unit, configured to establish a communication link between the wireless device and a communication network using a network communication protocol when the communication link with the access node is not detected;

an access node unit, configured to transmit an indication that the wireless device can provide wireless communications to a second wireless device using a cellular radio access technology, and to grant a communication channel to the second wireless device in response to a communication channel request from the second wireless device, wherein the communication controller unit is further configured to store a network location for the second wireless device when the second wireless device enters a lower power state and instruct the access node unit to send a paging message to the second wireless device when data arrives at the first wireless device for the second wireless device; and

a gateway unit, configured to assign a network address to the second wireless device to enable the second wireless device to communicate over the communication network.

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