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(54) Title: A SYSTEM AND METHOD FOR WALKING UP A WIRELESS DEVICE BY AN INTERNET ENABLED WIRELESS NETWORK

(57) Abstract: A method and device for waking up a wireless device is disclosed. The method includes configuring the wireless device based on a set of Discontinuous Reception (DRX) parameters associated with a first wireless network from the plurality of communication networks. The method further includes activating, by the wireless device, a sleep state based on the set of DRX parameters in response to non-receipt of paging message from the first wireless network for a predefined time period. The method includes waking the wireless device from the sleep state based on a wake-up signal received through at least one second wireless network from the plurality of wireless networks.

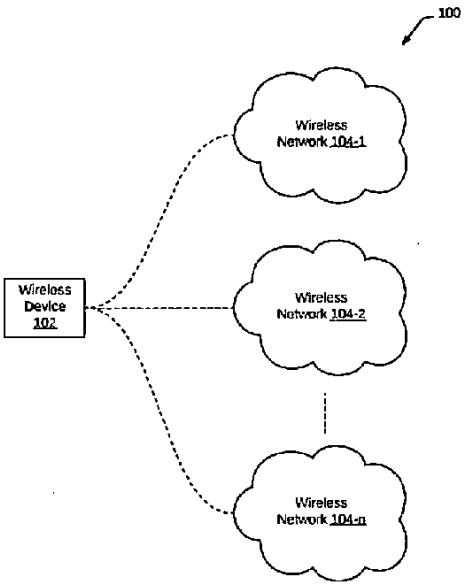
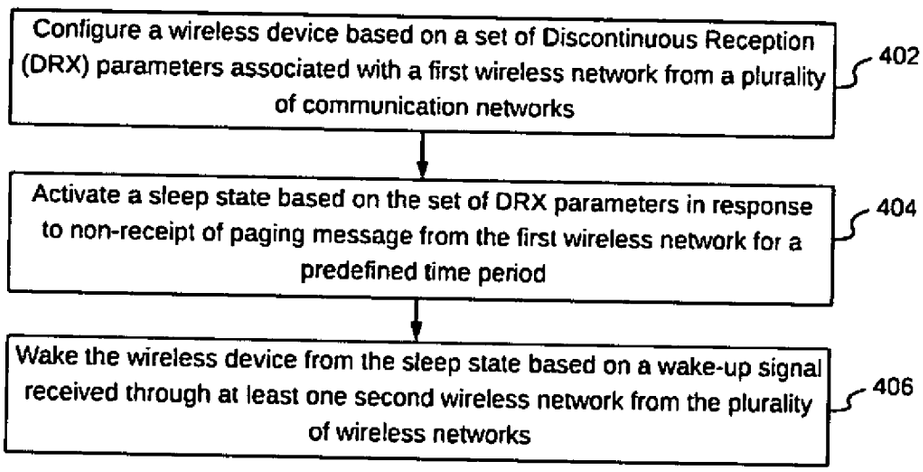


Figure 1

ABSTRACT

A System and Method for Waking up a Wireless Device by an Internet Enabled Wireless Network

A method and device for waking up a wireless device is disclosed. The method includes configuring the wireless device based on a set of Discontinuous Reception (DRX) parameters associated with a first wireless network from the plurality of communication networks. The method further includes activating, by the wireless device, a sleep state based on the set of DRX parameters in response to non-receipt of paging message from the first wireless network for a predefined time period. The method includes waking the wireless device from the sleep state based on a wake-up signal received through at least one second wireless network from the plurality of wireless networks.



We claim:

1. A method of waking up a wireless device communicatively coupled to a plurality of wireless networks, the method comprising:

configuring the wireless device based on a set of Discontinuous Reception (DRX) parameters associated with a first wireless network from the plurality of communication networks;

activating, by the wireless device, a sleep state based on the set of DRX parameters in response to non-receipt of paging message from the first wireless network for a predefined time period; and

waking the wireless device from the sleep state based on a wake-up signal received through at least one second wireless network from the plurality of wireless networks.

2. The method of claim 1 further comprising receiving, by the wireless device, the wake-up signal through the at least one second wireless network, wherein the wake-up signal is generated in response to a paging message initiated from the first wireless network, wherein the at least one second wireless network is communicatively coupled to the first wireless network.

3. The method of claim 1 further comprising registering, by the wireless device, at least one communication device based on at least one communication parameter of the wireless device, wherein each of the at least one communication device is associated with one of the at least one second wireless network.

4. The method of claim 3, wherein waking the wireless device comprises receiving the wake-up signal from one of the at least one communication device.

5. The method of claim 1, wherein the second wireless network is an internet enabled network.

6. A method of waking up a wireless device communicatively coupled to a plurality of wireless networks, the method comprising:

configuring at least one communication device based on at least one communication parameter of the wireless device, wherein each of the at least one communication device is associated with one of at least one second wireless network from the plurality of wireless networks;

identifying, by the at least one communication device, initiation of a paging message from a first wireless network in the plurality of wireless networks, wherein the at least one second wireless network is communicatively coupled to the first wireless network; and

sending, by one of the at least one communication device, a wake-up signal to the wireless device in response to identifying initiation of the paging message initiated from the first wireless network.

7. The method of claim 6, wherein the at least one communication parameter comprises Internet Protocol (IP) address of the wireless device.

8. A wireless device comprising:

at least one processor;

a memory coupled to the at least one processor, wherein the memory comprises processor instructions, which when executed cause the processor to:

configure the wireless device based on a set of Discontinuous Reception (DRX) parameters associated with a first wireless network from the plurality of communication networks;

activate a sleep state based on the set of DRX parameters in response to non-receipt of paging message from the first wireless network for a predefined time period; and

wake the wireless device from the sleep state based on a wake-up signal received through at least one second wireless network from the plurality of wireless networks.

DESCRIPTION

Technical Field

[001] This disclosure relates generally to discontinuous reception for wireless devices, and more particularly to method and device for waking up a wireless device.

Background

[002] A wireless device or user equipment may be allowed to periodically switch off its receiver for some time before it has to listen again to the control channel to check whether the network has new data for the wireless device. The on and off times for the wireless device can be configured dynamically based on activity of the wireless device.

[003] In order to configure on and off times for a wireless device, when the network configures Discontinuous Reception (DRX) for the wireless device, the network defines the value for a timer that starts running after each data block has been sent. If no data was received during the short DRX cycle mode, the wireless device implicitly enters the long DRX cycle which is much more power efficient but further increases latency time. The wireless device has to wake up based on DRX timers (short and long DRX cycle) and read paging signals. As a result, a sleep period that is too long may result in unnecessary or even unacceptable levels of delay in receiving a paging signal. On the other hand, a sleep period that is too short may significantly reduce the operating life of the device between recharges (i.e., by depleting battery power by waking up too frequently).

[004] There is therefore a need for a new DRX cycle which can keep the wireless device in sleep mode for longest duration without missing out on any paging signal.

SUMMARY

[005] In one embodiment, a method of waking up a wireless device communicatively coupled to a plurality of wireless networks is disclosed. The method includes configuring the wireless device based on a set of Discontinuous Reception (DRX) parameters associated with a first wireless network from the plurality of communication networks. The method further

includes activating, by the wireless device, a sleep state based on the set of DRX parameters in response to non-receipt of paging message from the first wireless network for a predefined time period. The method includes waking the wireless device from the sleep state based on a wake-up signal received through at least one second wireless network from the plurality of wireless networks.

[006] In another embodiment, a method of waking up a wireless device communicatively coupled to a plurality of wireless networks is disclosed. The method includes configuring at least one communication device based on at least one communication parameter of the wireless device, wherein each of the at least one communication device is associated with one of at least one second wireless network from the plurality of wireless networks. The method further includes identifying, by the at least one communication device, initiation of a paging message from a first wireless network in the plurality of wireless networks, wherein the at least one second wireless network is communicatively coupled to the first wireless network. The method includes sending, by one of the at least one communication device, a wake-up signal to the wireless device in response to identifying initiation of the paging message initiated from the first wireless network.

[007] In yet another embodiment, a wireless device is disclosed. The wireless device includes at least one processor and a memory coupled to the at least one processor, wherein the memory comprises processor instructions, which when executed cause the processor to configure the wireless device based on a set of Discontinuous Reception (DRX) parameters associated with a first wireless network from the plurality of communication networks; activate a sleep state based on the set of DRX parameters in response to non-receipt of paging message from the first wireless network for a predefined time period; and wake the wireless device from the sleep state based on a wake-up signal received through at least one second wireless network from the plurality of wireless networks.

[008] In another embodiment, a communication device is disclosed. The communication device includes at least one processor and a memory coupled to the at least one processor, wherein the memory comprises processor instructions, which when executed cause the processor to configure the communication device based on at least one communication parameter of a wireless device, wherein the communication device is associated with a second

wireless network from the plurality of wireless networks; identify initiation of a paging message from a first wireless network in the plurality of wireless networks, wherein the second wireless network is communicatively coupled to the first wireless network; and send a wake-up signal to the wireless device in response to identifying initiation of the paging message initiated from the first wireless network.

[009] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[010] The accompanying drawings, which are incorporated in and constitute a part of this disclosure, illustrate exemplary embodiments and, together with the description, serve to explain the disclosed principles.

[011] **FIG. 1** illustrates an environment in which various embodiments may be employed.

[012] **FIG. 2** illustrates communication of a wireless devices with a first wireless network and a second wireless network to enable waking up of the wireless device through the second wireless network, in accordance with an embodiment.

[013] **FIG. 3** illustrates a block diagram depicting communication flow amongst a wireless device 102, a communication device, a first wireless network, and a second wireless network, in accordance with an embodiment.

[014] **FIG. 4** illustrates a flowchart of a method of waking up a wireless device communicatively coupled to a plurality of wireless networks, in accordance with an embodiment.

[015] **FIG. 5** illustrates a flowchart of a method for configuring a wireless device based on a set of DRX parameters associated with a first wireless network, in accordance with an embodiment.

[016] **FIG. 6** illustrates a flowchart of a method of waking up a wireless device through one or more communication devices based on communication parameters of the wireless device, in accordance with an embodiment.

[017] **FIG. 7** illustrates a flowchart of a method of waking up a wireless device communicatively coupled to a plurality of wireless networks, in accordance with another embodiment.

[018] **FIG. 8** illustrates a flowchart of a method of waking up a wireless device by a communication device through a second wireless network, in accordance with an embodiment.

[019] **FIG. 9** illustrates a block diagram of an exemplary computer system for implementing embodiments consistent with the present disclosure.

DETAILED DESCRIPTION

[020] Exemplary embodiments are described with reference to the accompanying drawings. Wherever convenient, the same reference numbers are used throughout the drawings to refer to the same or like parts. While examples and features of disclosed principles are described herein, modifications, adaptations, and other implementations are possible without departing from the spirit and scope of the disclosed embodiments. It is intended that the following detailed description be considered as exemplary only, with the true scope and spirit being indicated by the following claims. Additional illustrative embodiments are listed below.

[021] In one embodiment, an environment 100 (that is exemplary) in which various embodiments may be employed is illustrated in FIG. 1. The environment 100 includes a wireless device 102 that is configured to facilitate wireless communication with other communication devices. The wireless device 102 may be a mobile device. By way of an example, the wireless device 102 may be implemented as, but not limited to a smartphone, a tablet, a netbook, an e-reader, a Personal Data Assistant (PDA), a vehicular communication system within a vehicle, a computer, a laptop, a wearable device (for example, a smart watch or smart glasses), a music playing device, a location-aware device. Alternatively, the wireless device 102 may be a fixed device. In other words, the wireless device 102 may be intended to be stationary at a given place in a given time. By way of an example, the wireless device 102

may be implemented as a kiosk, a Point Of Sale (POS) terminal, a vending machine, a set-top box, a smart television, a parking meter, or a sensor.

[022] The wireless device 102 (whether implemented as a mobile device or a fixed device) may be communicatively coupled to one or more of a plurality of wireless networks 104, illustrated as wireless networks 104-1 to 104-n. Examples of the plurality of wireless networks 104 may include, but are not limited to Wi-Fi, Bluetooth, a Code Division Multiple Access (CDMA) network, ZigBee, infrared, Global System for Mobile communication (GSM), Long Term Evolution (LTE), Worldwide Interoperability for Microwave Access (WiMax), Light Fidelity (Li-Fi), or other 4G and 5G networks.

[023] One of the plurality of wireless networks 104 is the primary wireless network that may provide various communication services to the wireless device 102. By way of an example, the wireless network 104-1 may be an LTE network that provides communication services, for example, calling and messaging services, to the wireless device 102. Similarly, one of the plurality of wireless networks 104 is the secondary wireless networks that may provide Internet (for example, Wi-Fi) or other close range connectivity services (for example, Bluetooth, ZigBee, or Li-Fi) to the wireless device 102. This is further explained in detail in conjunction with FIG. 2.

[024] Referring now to FIG. 2, illustrates communication of the wireless devices 102 with the wireless network 104-1 and the wireless network 104-2 to enable waking up of the wireless device 102 through the wireless network 104-2, in accordance with an embodiment.

[025] The wireless network 104-1, for example, may be an LTE network, a GSM, a CDMA network or any other 2G, 3G, 4G, or 5G mobile network. A core network 202 of the wireless network 104-1 may send a set of Discontinuous Reception (DRX) parameters to the wireless device 102. The set of DRX parameters may include instructions for the wireless device 102, such that, if the wireless device 102 does not receive a paging message for a predefined period of time, the wireless device 102 should activate a sleep mode for an infinite time period. In the sleep mode, the wireless device may be non-responsive to any paging message received from the core network 202. The paging message, for example, may be downlink data that may include, but is not limited to, downlink data, earthquake warning, tsunami warning, or fall back to lower access technologies.

[026] The wireless network 104-2 may be an internet enabled network, for example, a Wi-Fi network. Alternatively, the wireless network 104-2 may be a Bluetooth network, a ZigBee network, or a Li-Fi network. The communication of the wireless device 102 with the wireless network 104-2 may be enabled through a communication device 204 associated with the wireless network 104-2. The communication device 104, for example, may be a mobile device, a router, a server, a hotspot, or any other type of access point. By way of an example, when the wireless network 104-2 is Wi-Fi network that provides internet access, the communication device 204 may be a Wi-Fi router. By way of another example, when the wireless network 104-2 is a Bluetooth network, the communication device 204 may be a Bluetooth enabled mobile device.

[027] The wireless network 104-2 may be communicatively coupled to the wireless network 104-1. The wireless network 104-2 may be configured to identify initiation of a paging message from the core network 202 for the wireless device 102, when the wireless device 102 is in an infinite sleep mode. In an embodiment, the wireless network 104-2 may enable communication between the core network 202 and the wireless device 102, via the wireless network 104-2. The communication may be enabled based on one or more communication parameters associated with the wireless device 102. Examples of the one or more communication parameters may include, but are not limited to Internet Protocol (IP) address or Bluetooth ID.

[028] In response to identifying initiation of a paging message, the wireless network 104-2 may generate a wake-up signal, which may be received by the wireless device 102 through the communication device 204. The wake-up signal may trigger a service or application installed on the wireless device 102. The wireless device 102 wakes up from the infinite sleep mode after receiving the wake-up signal and receives the paging message from the wireless network 104-1. This is further explained in detail in conjunction with FIG. 3.

[029] Referring now to FIG. 3, a block diagram depicting communication flow amongst the wireless device 102, the communication device 204, the wireless network 104-1, and the wireless network 104-2 is illustrated, in accordance with an embodiment. The wireless device 102 includes a processor 302 that is communicatively coupled to a memory 304 and a communication module 306. The memory 304 may store processor instructions that, when

executed by the processor 302, cause the processor 302 to activate a sleep state of the wireless device 102 for an infinite time period and to subsequently wake up the wireless device 102 on receipt of a wake-up signal, as discussed in greater detail in FIG. 4 to FIG. 8. The memory 302 may be a non-volatile memory or a volatile memory. Examples of non-volatile memory, may include, but are not limited to a flash memory, a Read Only Memory (ROM), a Programmable ROM (PROM), Erasable PROM (EPROM), and Electrically EPROM (EEPROM) memory. Examples of volatile memory may include, but are not limited to Dynamic Random Access Memory (DRAM), and Static Random-Access memory (SRAM).

[030] The memory 304 further includes a DRX module 308 and a wake-up module 310. The DRX module 308 receives a set of DRX parameters from the core network 202 of the wireless network 104-1 and stores them. The set of DRX parameters are received from the core network 202, through the communication module 304. The communication module 304 enables the wireless device 102 to communicate with each of the communication device 204, the wireless network 104-1, and the wireless network 104-2. Based on the set of DRX parameters, the processor 302 instructs the wireless device 102 to activate sleep mode for infinite time period, when a paging message is not received from an access network 312 in the wireless network 104-1 for a predefine period of time. The wake-up module 310 receives a wake-up signal from the wireless network 104-2 or through communication device 204, when a paging message is initiated by the wireless network 104-1. The wake-up signal is received by the wireless device 102 from the wireless network 104-2 through the communication module 304. Once the wireless device 102 wakes up, the communication module 304 receives the paging message from the access network 312 and forwards the paging message to the processor 302, which performs an action based on the paging message.

[031] In order to enable the communication device 204 to send a wake-up signal, the wireless device 102 configures the communication device 204, which is associated with the wireless network 104-2. The communication device 204, for example, may be a server or a Wi-Fi router, when the wireless network 104-2 is an internet enabled network. The communication device 204 is configured and registered based on one or more communication parameters associated with the wireless device 102. The one or more communication parameters, for example, may include, but are not limited to IP address of the wireless device 102 or Bluetooth ID of the wireless device 102.

[032] The communication device 204 includes a processor 314 that is communicatively coupled to a memory 316, a wake-up module 318, and a communication module 320. The memory 316 includes processor instructions that, when executed by the processor 314, cause the processor 314 to send a wake-up signal to the wireless device 102 on initiation of a paging message from the access network 312 and based on a trigger from the core network 202, as discussed in greater detail in FIG. 4 to FIG. 8. The memory 316 may be a non-volatile memory or a volatile memory. Examples of non-volatile memory, may include, but are not limited to a flash memory, a Read Only Memory (ROM), a Programmable ROM (PROM), Erasable PROM (EPROM), and Electrically EPROM (EEPROM) memory. Examples of volatile memory may include, but are not limited to Dynamic Random Access Memory (DRAM), and Static Random-Access memory (SRAM). The memory 316 may also be used to store the one or more communication parameters associated with the wireless device 102. The wireless device 102 refreshes the one or more communication parameters in the memory 316, after expiry of a predefined time interval.

[033] The communication module 320 enables the communication device 204 to communicate with the wireless device 102, the wireless network 104-1, and the wireless network 104-2. Based on the one or more communication parameters, the communication module 320 receives a trigger from the core network 202 when a paging message is initiated by the access network 312. The communication module 320 the shares the information with the processor 314. In response, the processor 314 instructs the wake-up module 318 to generate a wake-up signal and send the same to the wireless device 102 either directly or through the wireless network 104-2. Additionally, or alternatively, the processor 314 may instruct the wake-up module 318 to generate and send a wake-up signal, when a communication parameter, for example, the IP address of the wireless device, has not been refreshed by the wireless device 102 in the memory 316, after expiry of the predefined time interval.

[034] Referring now to FIG. 4, a flowchart of a method of waking up the wireless device 102 communicatively coupled to the plurality of wireless networks 104 is illustrated, in accordance with an embodiment. The wireless device 102 is communicatively coupled to a first wireless network (for example, the wireless network 104-1, which is one of the wireless networks from the plurality of wireless networks 104). The first wireless network provides various communication services to the wireless device 102.

[035] At startup of the wireless device 102, the wireless device 102 receives a set of DRX parameters associated with the first wireless network from the core network (for example, the core network 202 of the wireless network 104-1). The set of DRX parameters include instructions for the wireless device 102 to switch to a sleep state, when a paging message has not been received for a predefined period of time from the core network. The predefined period of time may be defined by an administrator and may be fixed. Alternatively, the predefined period of time may be automatically adapted based on one or more factors, which may include, but are not limited to location of the wireless device 102 or communication history related to the wireless device 102.

[036] Using the set of DRX parameters, the wireless device 102 is configured at step 402. This is further explained in detail in conjunction with FIG. 5. Thereafter, in response to non-receipt of paging message from the first wireless network for the predefined time period, the wireless device 102 activates a sleep state based on the set of DRX parameters at step 404, for an infinite time period.

[037] At step 406, the wireless device 102 is woken from the sleep state based on a wake-up signal received through at least one second wireless network from the plurality of wireless networks 104. The at least one second wireless network, for example, may include the wireless network 104-2. The at least one second wireless network is communicatively coupled to the first wireless network and the wake-up signal is generated by the at least one second wireless network in response to a trigger received from the core network, when a paging message is initiated from the first wireless network for the wireless device 102. By way of an example, when the wireless network 104-1 initiates a paging message for the wireless device 102, which has entered a sleep state for an infinite period of time, the core network 202 sends a trigger to the wireless network 104-2, based on which it determines initiation of the paging message and generates a wake-up signal that is sent to the wireless device 102. In response to receiving the wake-up signal, the wireless device 102 wakes up from the sleep state and receives the paging request from the wireless network 104-1.

[038] Referring now to FIG. 5, a flowchart of a method for configuring the wireless device 102 based on a set of DRX parameters associated with a first wireless network is illustrated, in accordance with an embodiment. When the wireless device 102 is switched on,

the wireless device 102 receives a set of DRX parameters from a core network of the first wireless network at step 502. The first wireless network, for example, may be the wireless network 104-1. The set of DRX parameters may include instructions for the wireless device 102 to switch to a sleep state for an infinite period, if no paging message is received from the core network of the first wireless network for a predefined period of time. As explained before, the predefined period of time may either be fixed or may be automatically adapt based on one or more factors.

[039] Once the set of DRX parameters are received by the wireless device 102, the wireless device 102 stores the set of DRX parameters in the memory 304 at step 504. Thus, on subsequent startup of the wireless device 102, the wireless device 102 may retrieve the set of DRX parameters directly from the memory 304. Additionally, if the core network sends a revised set of DRX parameters, the wireless device 102 updates the memory 304 with the revised set of DRX parameters. At step 506, the wireless device 102 configures itself based on the set of DRX parameters associated with the first wireless network, such that, the wireless device 102 switches to a sleep state for an infinite period, if no paging message is received from the core network for a predefined period of time.

[040] Referring now to FIG. 6, a flowchart of a method of waking up the wireless device 102 through one or more communication devices based on communication parameters of the wireless device 102 is illustrated, in accordance with an embodiment. At step 602, the wireless device 102 registers the one or more communication devices based on one or more communication parameters of the wireless device 102. The one or more communication parameters, for example, may include Internet Protocol (IP) address of the wireless device 102. Each of the one or more communication devices is associated with one of the at least one second wireless network. By way of an example, there may be three secondary wireless networks, the wireless network 104-2, which is an internet enabled Wi-Fi network, a wireless network 104-3, which a Bluetooth network, and a wireless network 104-4, which is a Li-Fi network. For the wireless network 104-2, an associated communication device may be a server or a Wi-Fi router and the IP address of the wireless device 102 may be registered with the server or the Wi-Fi router. Similarly, for the wireless network 104-3, an associated communication device may be a Bluetooth enabled mobile device and the Bluetooth ID of the wireless device 102 may be registered with the Bluetooth enabled mobile device.

[041] In an embodiment, the one or more communication devices may be registered based on location of the wireless device 102 and the location of each of the one or more communication devices. By way of an example, when a user of the wireless device 102 is at home, a Wi-Fi router in the user's home may be registered as the communication device that would generate and send a wake-up signal through the internet enabled Wi-Fi network. Similarly, when the user of the wireless device 102 is at office, a Wi-Fi router in the user's office may be registered as the communication device that would generate and send a wake-up signal. By way of another example, a Bluetooth enabled mobile device, which shares the same location as the wireless device 102 over a period of time (determined based on historical Global Positioning System data) may be registered as the communication device that would generate and send a wake-up signal through the Bluetooth network.

[042] After the one or more communication devices have been registered with the wireless device 102, when the wireless device 102 has activated the sleep state, one of the one or more communication devices may generate a wake-up signal upon receiving a trigger from the core network upon initiation of a paging message from the first wireless network. The communication device that generates the wake-up signal may depend on the current second wireless network that the wireless device 102 is connected to. In continuation of the example given above, when the wireless device 102 is connected to the wireless network 104-2 (which is an internet enabled Wi-Fi network), the server or the Wi-Fi router may generate the wake-up signal to be received by the wireless device 102.

[043] Alternatively, or additionally, as explained above, the communication device that generates the wake-up signal may depend upon the current location of the wireless device 102 and the current location of the communication device. In an embodiment, multiple communication devices may generate and send wake-up signals to the wireless device 102. In this case, the wireless device 102 may wake up in response to the first wake-up signal and may thus ignore the subsequent wake-up signals. Receiving multiple wake-up signals may ensure that the wireless device 102 wakes up, as one or more of the wake-up signals may fail to reach the wireless device 102.

[044] The wake-up signal is received by the wireless device 102 at step 604. Based on the wake-up signal, the wireless device 102 wakes up from the sleep state at step 606. This has been explained before in detail in conjunction with FIG. 5.

[045] Referring now to FIG. 7, a flowchart of a method of waking up the wireless device 102 communicatively coupled to the plurality of wireless networks 104 is illustrated, in accordance with another embodiment. Once the wireless device 102 has been configured with the set of DRX parameters, a check is performed at step 702 to determine if a predefined period of time has lapsed since a paging message was received from a first wireless network (for example, the wireless network 104-1). If the predefined time period has not expired, at step 704, the wireless device 102 instructs itself to remain in active mode.

[046] Referring back to step 702, if the predefined period of time has lapsed, the wireless device 102 activates a sleep state based on the set of DRX parameters for an infinite time period at step 706. At step 708, a core network of the first wireless network initiates a trigger upon generation of a paging message from the first wireless network. As the wireless device 102 is connected to a second wireless network, which is further communicatively coupled to the first wireless network, the second wireless network receives the trigger and identifies initiation of the paging message by the first wireless network. In response, the second wireless network generates a wake-up signal at step 710. At step 712, the wireless device 102 receives the wake-up signal and wakes up the wireless device 102 at step 714. Thereafter, at step 716, the wireless device 102 receives the paging message initiated by the first wireless network.

[047] Referring now to FIG. 8, a flowchart of a method of waking up the wireless device 102 by a communication device through a second wireless network is illustrated, in accordance with an embodiment. The communication device, for example, may be the communication device 204. The communication device is associated with the second wireless network (for example, the wireless network 104-2) that the wireless device 102 is connected to.

[048] At step 802, the communication device is configured based on one or more communication parameters associated with the wireless device 102. The communication device, for example, may be a server or a Wi-Fi router. This has been explained in detail in conjunction with FIG. 7. As the second wireless network is communicatively coupled to the first wireless

network, the communication device receives a trigger from the core network of the first wireless network and identifies initiation of a paging message from the first wireless network, at step 804. Thereafter, at step 806, the communication device sends a wake-up signal to the wireless device 102, in response to the trigger.

[049] FIG. 9 is a block diagram of an exemplary computer system for implementing various embodiments. Computer system 902 may include a central processing unit ("CPU" or "processor") 904. Processor 904 may include at least one data processor for executing program components for executing user- or system-generated requests. A user may include a person, a person using a device such as such as those included in this disclosure, or such a device itself. Processor 904 may include specialized processing units such as integrated system (bus) controllers, memory management control units, floating point units, graphics processing units, digital signal processing units, etc. Processor 904 may include a microprocessor, such as AMD® ATHLON® microprocessor, DURON® microprocessor OR OPTERON® microprocessor, ARM's application, embedded or secure processors, IBM® POWERPC®, INTEL'S CORE® processor, ITANIUM® processor, XEON® processor, CELERON® processor or other line of processors, etc. Processor 904 may be implemented using mainframe, distributed processor, multi-core, parallel, grid, or other architectures. Some embodiments may utilize embedded technologies like application-specific integrated circuits (ASICs), digital signal processors (DSPs), Field Programmable Gate Arrays (FPGAs), etc.

[050] Processor 904 may be disposed in communication with one or more input/output (I/O) devices via an I/O interface 906. I/O interface 906 may employ communication protocols/methods such as, without limitation, audio, analog, digital, monoaural, RCA, stereo, IEEE-1394, serial bus, universal serial bus (USB), infrared, PS/2, BNC, coaxial, component, composite, digital visual interface (DVI), high-definition multimedia interface (HDMI), RF antennas, S-Video, VGA, IEEE 802.n /b/g/n/x, Bluetooth, cellular (e.g., code-division multiple access (CDMA), high-speed packet access (HSPA+), global system for mobile communications (GSM), long-term evolution (LTE), WiMax, or the like), etc.

[051] Using I/O interface 906, computer system 902 may communicate with one or more I/O devices. For example, an input device 908 may be an antenna, keyboard, mouse, joystick, (infrared) remote control, camera, card reader, fax machine, dongle, biometric reader,

microphone, touch screen, touchpad, trackball, sensor (e.g., accelerometer, light sensor, GPS, gyroscope, proximity sensor, or the like), stylus, scanner, storage device, transceiver, video device/source, visors, etc. An output device 910 may be a printer, fax machine, video display (e.g., cathode ray tube (CRT), liquid crystal display (LCD), light-emitting diode (LED), plasma, or the like), audio speaker, etc. In some embodiments, a transceiver 912 may be disposed in connection with processor 904. Transceiver 912 may facilitate various types of wireless transmission or reception. For example, transceiver 912 may include an antenna operatively connected to a transceiver chip (e.g., TEXAS® INSTRUMENTS WILINK WL1283® transceiver, BROADCOM® BCM4550IUB8® transceiver, INFINEON TECHNOLOGIES® X-GOLD 718-PMB9800® transceiver, or the like), providing IEEE 802.11a/b/g/n, Bluetooth, FM, global positioning system (GPS), 2G/3G HSDPA/HSUPA communications, etc.

[052] In some embodiments, processor 904 may be disposed in communication with a communication network 914 via a network interface 916. Network interface 916 may communicate with communication network 914. Network interface 916 may employ connection protocols including, without limitation, direct connect, Ethernet (e.g., twisted pair 50/500/5000 Base T), transmission control protocol/internet protocol (TCP/IP), token ring, IEEE 802.11a/b/g/n/x, etc. Communication network 914 may include, without limitation, a direct interconnection, local area network (LAN), wide area network (WAN), wireless network (e.g., using Wireless Application Protocol), the Internet, etc. Using network interface 916 and communication network 914, computer system 902 may communicate with devices 918, 920, and 922. These devices may include, without limitation, personal computer(s), server(s), fax machines, printers, scanners, various mobile devices such as cellular telephones, smartphones (e.g., APPLE® IPHONE® smartphone, BLACKBERRY® smartphone, ANDROID® based phones, etc.), tablet computers, eBook readers (AMAZON® KINDLE® ereader, NOOK® tablet computer, etc.), laptop computers, notebooks, gaming consoles (MICROSOFT® XBOX® gaming console, NINTENDO® DS® gaming console, SONY® PLAYSTATION® gaming console, etc.), or the like. In some embodiments, computer system 902 may itself embody one or more of these devices.

[053] In some embodiments, processor 904 may be disposed in communication with one or more memory devices (e.g., RAM 926, ROM 928, etc.) via a storage interface 924. Storage interface 924 may connect to memory 930 including, without limitation, memory

drives, removable disc drives, etc., employing connection protocols such as serial advanced technology attachment (SATA), integrated drive electronics (IDE), IEEE-1394, universal serial bus (USB), fiber channel, small computer systems interface (SCSI), etc. The memory drives may further include a drum, magnetic disc drive, magneto-optical drive, optical drive, redundant array of independent discs (RAID), solid-state memory devices, solid-state drives, etc.

[054] Memory 930 may store a collection of program or database components, including, without limitation, an operating system 932, user interface application 934, web browser 936, mail server 938, mail client 940, user/application data 942 (e.g., any data variables or data records discussed in this disclosure), etc. Operating system 932 may facilitate resource management and operation of computer system 902. Examples of operating systems 932 include, without limitation, APPLE® MACINTOSH® OS X platform, UNIX platform, Unix-like system distributions (e.g., Berkeley Software Distribution (BSD), FreeBSD, NetBSD, OpenBSD, etc.), LINUX distributions (e.g., RED HAT®, UBUNTU®, KUBUNTU®, etc.), IBM® OS/2 platform, MICROSOFT® WINDOWS® platform (XP, Vista/9/8, etc.), APPLE® IOS® platform, GOOGLE® ANDROID® platform, BLACKBERRY® OS platform, or the like. User interface 934 may facilitate display, execution, interaction, manipulation, or operation of program components through textual or graphical facilities. For example, user interfaces may provide computer interaction interface elements on a display system operatively connected to computer system 902, such as cursors, icons, check boxes, menus, scrollers, windows, widgets, etc. Graphical user interfaces (GUIs) may be employed, including, without limitation, APPLE® Macintosh® operating systems' AQUA® platform, IBM® OS/2® platform, MICROSOFT® WINDOWS® platform (e.g., AERO® platform, METRO® platform, etc.), UNIX X-WINDOWS, web interface libraries (e.g., ACTIVEX® platform, JAVA® programming language, JAVASCRIPT® programming language, AJAX® programming language, HTML, ADOBE® FLASH® platform, etc.), or the like.

[055] In some embodiments, computer system 902 may implement a web browser 936 stored program component. Web browser 936 may be a hypertext viewing application, such as MICROSOFT® INTERNET EXPLORER® web browser, GOOGLE® CHROME® web browser, MOZILLA® FIREFOX® web browser, APPLE® SAFARI® web browser, etc. Secure web browsing may be provided using HTTPS (secure hypertext transport protocol), secure sockets layer (SSL), Transport Layer Security (TLS), etc. Web browsers may utilize facilities such as

AJAX, DHTML, ADOBE® FLASH® platform, JAVASCRIPT® programming language, JAVA® programming language, application programming interfaces (APis), etc. In some embodiments, computer system 902 may implement a mail server 938 stored program component. Mail server 938 may be an Internet mail server such as MICROSOFT® EXCHANGE® mail server, or the like. Mail server 938 may utilize facilities such as ASP, ActiveX, ANSI C++/C#, MICROSOFT .NET® programming language, CGI scripts, JAVA® programming language, JAVASCRIPT® programming language, PERL® programming language, PHP® programming language, PYTHON® programming language, WebObjects, etc. Mail server 938 may utilize communication protocols such as internet message access protocol (IMAP), messaging application programming interface (MAPI), Microsoft Exchange, post office protocol (POP), simple mail transfer protocol (SMTP), or the like. In some embodiments, computer system 902 may implement a mail client 940 stored program component. Mail client 940 may be a mail viewing application, such as APPLE MAIL® mail client, MICROSOFT ENTOURAGE® mail client, MICROSOFT OUTLOOK® mail client, MOZILLA THUNDERBIRD® mail client, etc.

[056] In some embodiments, computer system 902 may store user/application data 942, such as the data, variables, records, etc. as described in this disclosure. Such databases may be implemented as fault-tolerant, relational, scalable, secure databases such as ORACLE® database OR SYBASE® database. Alternatively, such databases may be implemented using standardized data structures, such as an array, hash, linked list, struct, structured text file (e.g., XML), table, or as object-oriented databases (e.g., using OBJECTSTORE® object database, POET® object database, ZOPE® object database, etc.). Such databases may be consolidated or distributed, sometimes among the various computer systems discussed above in this disclosure. It is to be understood that the structure and operation of the any computer or database component may be combined, consolidated, or distributed in any working combination.

[057] It will be appreciated that, for clarity purposes, the above description has described embodiments of the invention with reference to different functional units and processors. However, it will be apparent that any suitable distribution of functionality between different functional units, processors or domains may be used without detracting from the invention. For example, functionality illustrated to be performed by separate processors or controllers may be performed by the same processor or controller. Hence, references to specific

functional units are only to be seen as references to suitable means for providing the described functionality, rather than indicative of a strict logical or physical structure or organization.

[058] Various embodiments of the invention provide method and device for waking up a wireless device. The method provides an improved DRX that allow a wireless device to sleep till no paging message is initiated for the wireless device. In other words, the wireless device may remain in sleep for unlimited amount of time, without missing out on any paging message. This further ensures improved battery performance and increased battery life for the wireless device. The specification has described method and device for waking up a wireless device. The illustrated steps are set out to explain the exemplary embodiments shown, and it should be anticipated that ongoing technological development will change the manner in which particular functions are performed. These examples are presented herein for purposes of illustration, and not limitation. Further, the boundaries of the functional building blocks have been arbitrarily defined herein for the convenience of the description. Alternative boundaries can be defined so long as the specified functions and relationships thereof are appropriately performed. Alternatives (including equivalents, extensions, variations, deviations, etc., of those described herein) will be apparent to persons skilled in the relevant art(s) based on the teachings contained herein. Such alternatives fall within the scope and spirit of the disclosed embodiments.

[059] Furthermore, one or more computer-readable storage media may be utilized in implementing embodiments consistent with the present disclosure. A computer-readable storage medium refers to any type of physical memory on which information or data readable by a processor may be stored. Thus, a computer-readable storage medium may store instructions for execution by one or more processors, including instructions for causing the processor(s) to perform steps or stages consistent with the embodiments described herein. The term "computer-readable medium" should be understood to include tangible items and exclude carrier waves and transient signals, i.e., be non-transitory. Examples include random access memory (RAM), read-only memory (ROM), volatile memory, nonvolatile memory, hard drives, CD ROMs, DVDs, flash drives, disks, and any other known physical storage media.

[060] It is intended that the disclosure and examples be considered as exemplary only, with a true scope and spirit of disclosed embodiments being indicated by the following claims.

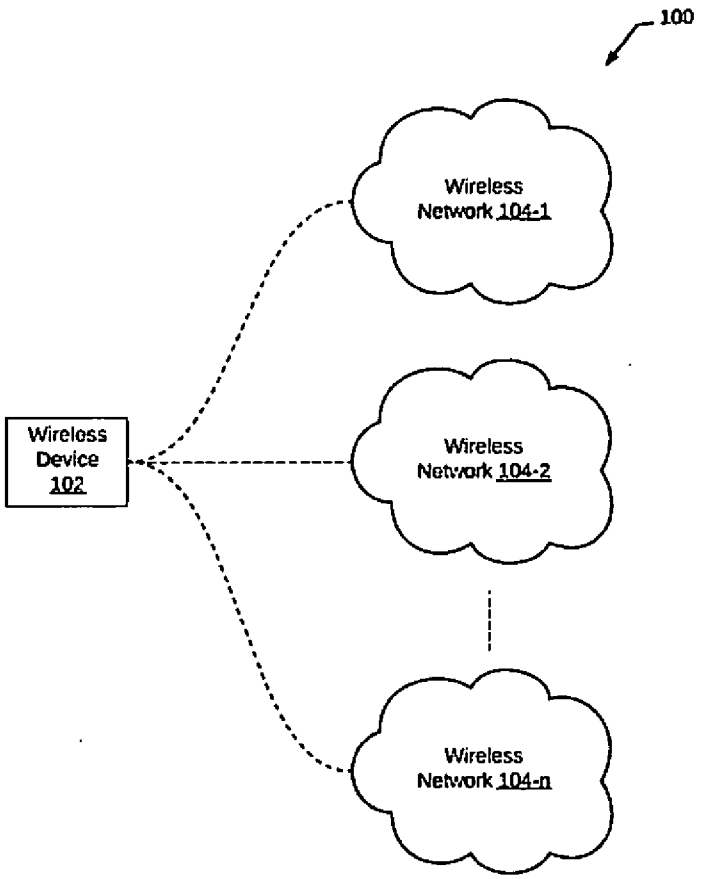


Figure 1

Mohammed Faisal (INPA No: 1941)
Head, IPR Dept.
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DLF 3rd Block, 2nd Floor,
Manapakkam, Chennai – 600089

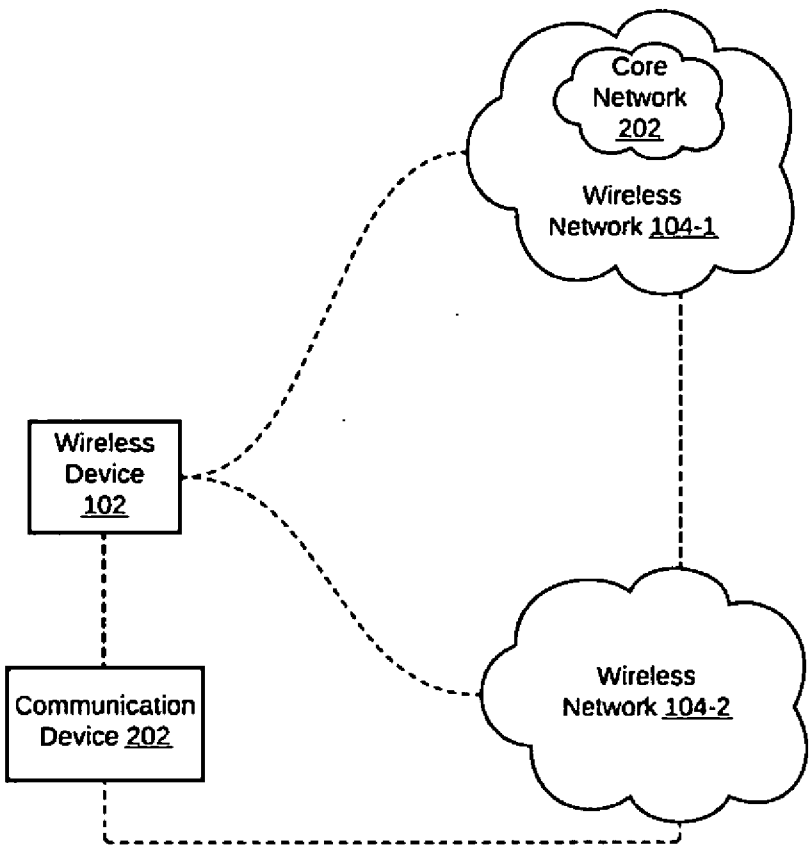

Figure 2

Mohammed Faisal (INPA No: 1941)
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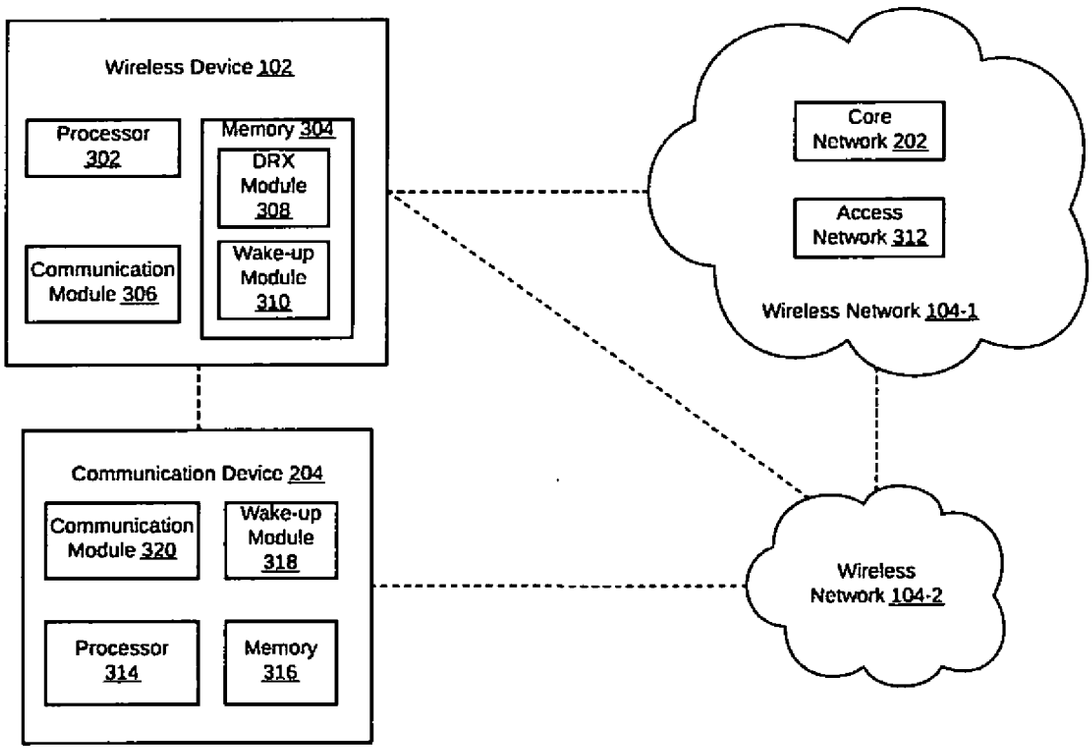

Figure 3

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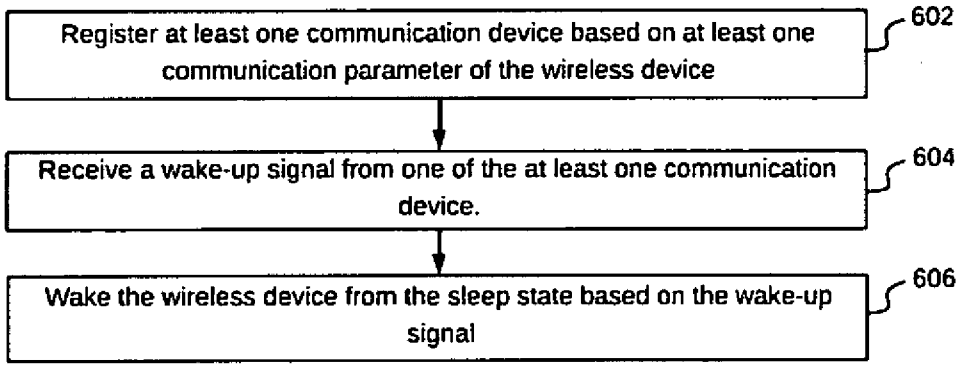

Figure 6

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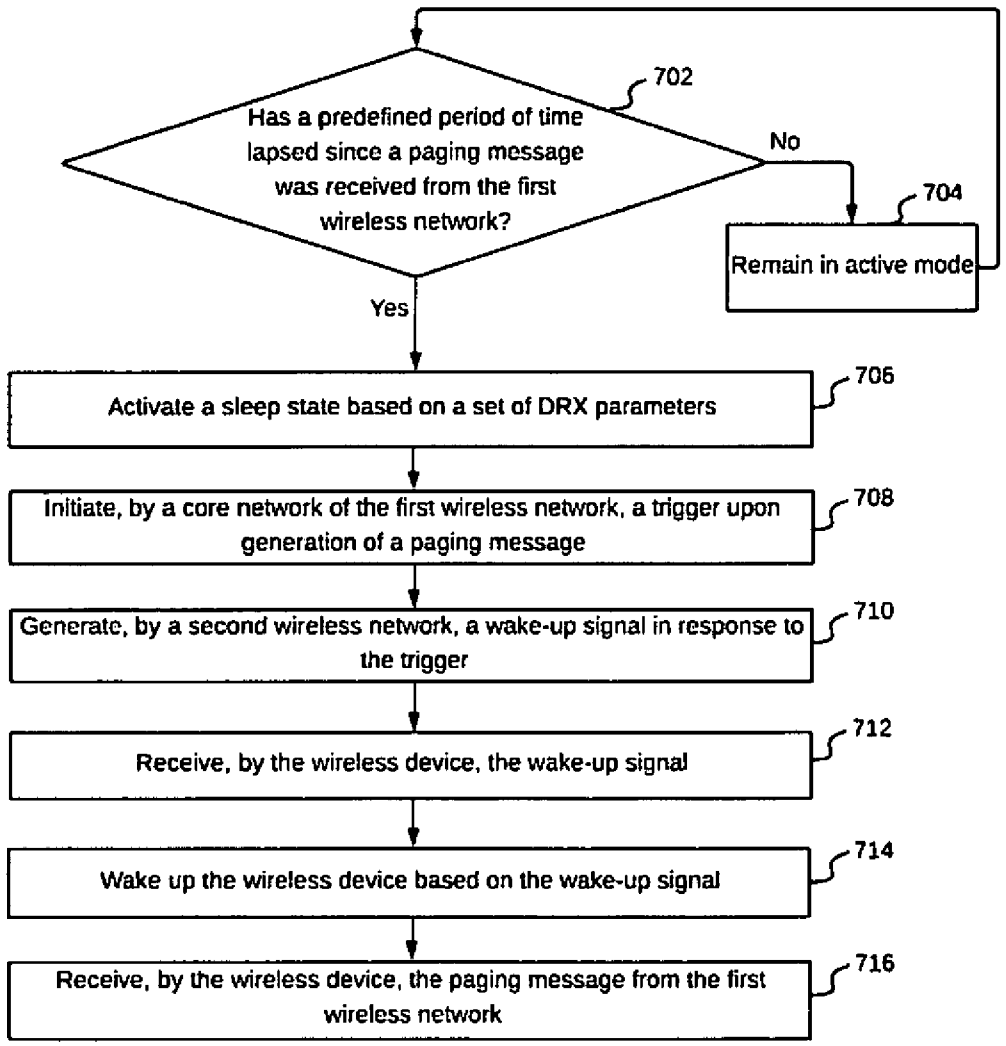

Figure 7

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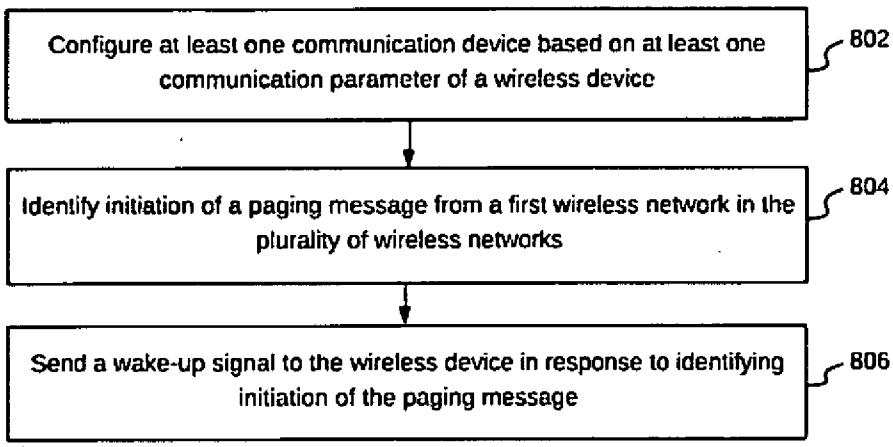

Figure 8

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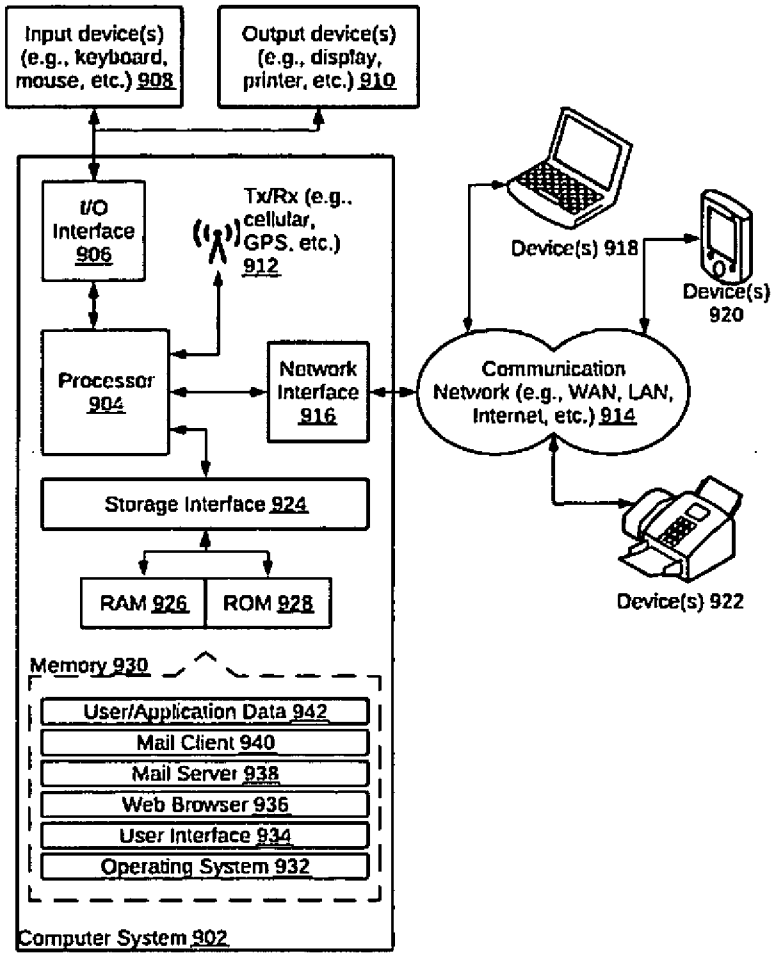

Figure 9

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