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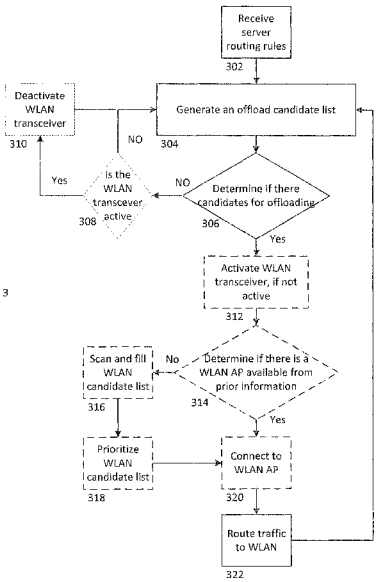


Figure 3

(57) Abstract: A method, apparatus and computer program product are provided for facilitate adaptive candidate list population for WLAN offloading. A method is provided for receiving routing rules and generating an offload candidate list, wherein the offload candidate list comprises applications or application traffic. The method also includes determining5 offload candidates of the offload candidate list which can be routed to a wireless local area network (WLAN) based on the routing rules and routing at least one offload candidate from the offload candidate list to the WLAN.

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METHOD AND APPARATUS FOR ADAPTIVE CANDIDATE LIST POPULATION FOR WLAN OFFLOADING

TECHNOLOGICAL FILED

An example embodiment of the present invention relates to wireless communication and, more particularly, adaptive candidate list population for wireless local area network (WLAN) offloading.

BACKGROUND

Current user equipment (UE), such as mobile phone, protocols may activate and connect to a WLAN for offloading purposes even when no offloading may be performed per the server routing rules from the network, such as a third generation partnership project (3GPP) network. The failure to optimize WLAN usage, by limiting the WLAN activations and connections wastes valuable processing and battery power.

BRIEF SUMMARY

A method, apparatus and computer program product are provided in accordance with an example embodiment in order to facilitate adaptive candidate list population for WLAN offloading. In an example embodiment, a method is provided that includes receiving server routing rules and generating an offload candidate list. The offload candidate list includes applications or application traffic. The method also includes determining offload candidates of the offload candidate list which can be routed to a wireless local area network (WLAN) based on the server routing rules and routing at least one offload candidate from the offload candidate list to the WLAN.

In an example embodiment the method also includes activating a WLAN transceiver in response to determining at least one of the offload candidates can be routed to the WLAN. An example embodiment of this method includes determining if a WLAN access point (AP) is available based on the server routing rules. In an instance in which a WLAN AP is known the method also includes connecting to the WLAN AP. In an

instance in which a WLAN AP is not known, the method also includes generating a WLAN candidate list. The generating a WLAN access list includes scanning for WLAN APs and filling the list with the WLAN AP information. The method also includes prioritizing the WLAN candidate list and connecting to the highest priority WLAN AP from the WLAN candidate list.

In an example embodiment the method also includes deactivating a WLAN transceiver in response to determining none of the offload candidates can be routed to the WLAN. In an example embodiment of the method the generating an offload candidate list is performed in response to changes in application status or application traffic status. In an example embodiment of the method the server routing rules are received using an access network discovery and selection function (ANDSF). In an example embodiment of the method the application or application traffic comprises traffic through an access point name (APN), an active service, an active application, a traffic stream, or a traffic flow.

In an example embodiment an apparatus is provided including at least one processor and at least one memory including computer program code with at least one memory and computer program code configured to, with the processor, cause the apparatus to at least receive server routing rules and generate an offload candidate list. The offload candidate list includes applications or application traffic. The at least one memory and the computer program code may also be configured to, with the processor, cause the apparatus of the example embodiment to determine offload candidates of the offload candidate list which can be routed to a wireless local area network (WLAN) based on the server routing rules and route at least one offload candidate from the offload candidate list to the WLAN.

The at least one memory and the computer program code may be further configured to, with the processor, cause the apparatus of the example embodiment to activate a WLAN transceiver in response to determining at least one of the offload candidates can be routed to the WLAN. The at least one memory and the computer program code may be further configured to, with the processor, cause the apparatus of the example embodiment to determine if a WLAN access point (AP) is available based on the server routing rules. In an instance in which a WLAN AP is known the at least one memory and the computer program code are further configured to connect to the WLAN AP. In an instance in which a WLAN AP is not known, the at least one memory and the computer program code are further configured to generate a WLAN candidate list. The generating a WLAN access list includes scanning for WLAN APs and filling the list with the WLAN AP information. The at least one memory and the computer program code are

also configured to prioritize the WLAN candidate list and connect to the highest priority WLAN AP from the WLAN candidate list.

The at least one memory and the computer program code may be further configured to, with the processor, cause the apparatus of the example embodiment to deactivate a WLAN transceiver in response to determining none of the offload candidates can be routed to the WLAN. In an example embodiment of the apparatus the generating an offload candidate list is performed in response to changes in application status or application traffic status. In an example embodiment of the apparatus the server routing rules are received using an access network discovery and selection function (ANDSF). In an example embodiment of the apparatus the application or application traffic comprises traffic through an access point name (APN), an active service, an active application, a traffic stream, or a traffic flow.

In an example embodiment a computer program product is provided including at least one non-transitory computer-readable storage medium having computer-executable program portions stored therein with the computer-executable program portions including program code instructions configured to receive server routing rules and generate an offload candidate list. The offload candidate list includes applications or application traffic. The computer-executable program code portions of the example embodiment of the computer program product also include program code instructions configured to determine offload candidates of the offload candidate list which can be routed to a wireless local area network (WLAN) based on the server routing rules and route at least one offload candidate from the offload candidate list to the WLAN.

The computer-executable program code portions of an example embodiment of a computer program product may also include program code instructions configured to activate the WLAN transceiver in response to determining at least one of the offload candidates can be routed to the WLAN. The computer-executable program code portions of an example embodiment of the computer program product may also include program code instructions configured to determine if a WLAN access point (AP) is available based on the server routing rules. In an instance in which a WLAN AP is known the computer-executable program code portions also include program code instructions configured to connect to the WLAN AP. In an instance in which a WLAN AP is not known, the computer-executable program code portions also include program code instructions configured to generate a WLAN candidate list. The generating a WLAN access list comprises scanning for WLAN APs and filling the list with the WLAN AP information. The computer-executable program code portions also include program code instructions configured to prioritize the WLAN candidate list and connect to the highest priority WLAN AP from the WLAN candidate list.

The computer-executable program code portions of an example embodiment of the computer program product may also include program code instructions configured to deactivating a WLAN transceiver in response to determining none of the offload candidates can be routed to the WLAN. In an example embodiment of the computer program product the generating an offload candidate list is performed in response to changes in application status or application traffic status. In an example embodiment of the computer program product the server routing rules are received using an access network discovery and selection function (ANDSF).

In yet another example embodiment, an apparatus is provided that includes means for receiving server routing rules, and means for generating an offload candidate list. The offload candidate list comprises applications or application traffic. The apparatus may also include means for determining offload candidates of the offload candidate list which can be routed to a wireless local area network (WLAN) based on the server routing rules and means for routing at least one offload candidate from the offload candidate list to the WLAN.

BRIEF DESCRIPTION OF THE DRAWINGS

Having thus described example embodiments of the invention in general terms, reference will now be made to the accompanying drawings, which are not necessarily drawn to scale, and wherein:

Figure 1 illustrates a communications diagram in accordance with an example embodiment of the present invention;

Figure 2 is a block diagram of an apparatus that may be specifically configured for adaptive candidate list population for wireless local area network (WLAN) offloading in accordance with an example embodiment of the present invention; and

Figure 3 is a flow chart illustrating the operations performed, such as by the apparatus of Figure 2, in accordance with an example embodiment of the present invention.

DETAILED DESCRIPTION

Some embodiments of the present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which some, but not all, embodiments of the invention are shown. Indeed, various embodiments of the invention may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this

disclosure will satisfy applicable legal requirements. Like reference numerals refer to like elements throughout. As used herein, the terms "data," "content," "information," and similar terms may be used interchangeably to refer to data capable of being transmitted, received and/or stored in accordance with embodiments of the present invention. Thus, use of any such terms should not be taken to limit the spirit and scope of embodiments of the present invention.

Additionally, as used herein, the term 'circuitry' refers to (a) hardware-only circuit implementations (e.g., implementations in analog circuitry and/or digital circuitry); (b) combinations of circuits and computer program product(s) comprising software and/or firmware instructions stored on one or more computer readable memories that work together to cause an apparatus to perform one or more functions described herein; and (c) circuits, such as, for example, a microprocessor(s) or a portion of a microprocessor(s), that require software or firmware for operation even if the software or firmware is not physically present. This definition of 'circuitry' applies to all uses of this term herein, including in any claims. As a further example, as used herein, the term 'circuitry' also includes an implementation comprising one or more processors and/or portion(s) thereof and accompanying software and/or firmware. As another example, the term 'circuitry' as used herein also includes, for example, a baseband integrated circuit or applications processor integrated circuit for a mobile phone or a similar integrated circuit in a server, a cellular network device, other network device, and/or other computing device.

As defined herein, a "computer-readable storage medium," which refers to a non-transitory physical storage medium (e.g., volatile or non-volatile memory device), can be differentiated from a "computer-readable transmission medium," which refers to an electromagnetic signal.

A method, apparatus and computer program product are provided in accordance with an example embodiment for multi-resolution point of interest boundary identification in digital map rendering.

Figure 1 illustrates a communication diagram including a user equipment (UE) 10, wireless local area network WLANs 12, and a cellular network 14. The UE may be in data communication with the cellular network 14 and/or one or several WLANs 12.

In an example embodiment the UE 10 may receive server routing rules form the cellular network, such as a 3GPP network. Routing rules may be described in a Management Object (MO) distributed by the ANDSF. Various other ways to configure the routing rules exist, like Open Mobile Alliance (OMA) device Management (DM) MOs and Hotspot (HS2.0) MOs, or the rules may be provisioned to the subscription module or they may be loadable from an application store, e.g. as connectivity settings. The server routing rules may be pre-provisioned to the UE 10, such as during attachment of the UE

10 to a home network. In an example embodiment the server routing rules may be provisioned using an access network discovery and selection function (ANDSF). The use of an ANDSF may allow the cellular network 14 to update the server routing rules as necessary. Additionally or alternatively the UE may receive the server routing rules from service provider as pre-provisioned during manufacture, at the point of sale, or from service provider using SOAP-XML instead of OMA-DM, or the like.

The UE may generate a candidate list of applications or application traffic that may be offloaded to a WLAN, based on the server routing rules. The offload candidate list may include applications, traffic streams associated with applications, access point names (APNs), destination addresses/ports (in internet protocol (IP) level) running in the UE. Based on the server routing rules the UE 10 may determine if any of the offload candidates from the offload candidate list may be routed to a WLAN 12. For examiner the UE 10 may determine offload candidates to route to the WLAN 12 based on used internes protocol version (according to the ANDSF), IP addresses (including range addresses), protocol type, port numbers (including range or ports), or the like, included in the server routing rules. The UE 10 may also check the validity conditions for WLAN. The UE 10 may evaluate the offload candidate list in response to WLAN conductivity becoming available, a change in application status of an offload candidate, a change in application traffic status of an offload candidate, or the like.

In an instance in which there is an offload candidate that may be routed to a WLAN 12, the UE 10 may determine the status of a WLAN transceiver associated with the UE, and activate the WLAN transceiver if not previously active. In an instance in which a WLAN AP in proximity, based on the server routing rules, is known to the UE 10, the UE may connect directly to the known WLAN AP and route the offload candidate to the WLAN 12.

In an instance in which a WLAN AP is not known to the UE 10, the UE may scan for available WLAN APs and fill a WLAN AP candidate list. The UE 10 may prioritize the WLAN AP candidate list based on the server routing rules. For example, the UE 10 may prioritize WLAN APs based on signal strength indicators, such as received signal strength indicator, received signal to noise indicator, previous connection to the WLAN AP, home or visiting WLAN classifications, or the like. The UE may then connect to the WLAN AP with the highest priority in the WLAN AP candidate list.

Once the UE 10 has established a connection to a WLAN AP the UE may route the identified offload candidate traffic according to the server routing rules. As an example, the UE may route all traffic destined to the well-known port, such as port numbers “80” or “443”, to go through WLAN 12. The UE 10 may continue to evaluate applications and application traffic for inclusion of the offload candidate list and/or WLAN

offload periodically or based on changes in connectivity or application status, such as, starring new applications, application traffic steam changes, or the like. In an instance in which no offload candidates may be routed to the WLAN 12, the UE 10 may deactivate the WLAN transceiver. The deactivation of the WLAN transceiver when there is not an offload candidate for routing to the WLAN or other service utilizing the WLAN conserves processing and battery power. Processing and battery power is further utilized by activating the WLAN transceiver when an offload candidate has been identified.

Example Apparatus

A UE 10 may include or otherwise be associated with an apparatus 200 as shown in Figure 2. The apparatus, such as that shown in Figure 2, is specifically configured in accordance with an example embodiment of the present invention to provide for facilitate adaptive candidate list population for WLAN offloading. The apparatus may include or otherwise be in communication with a processor 22, a memory device 24, a communication interface 26, and a user interface 28. In some embodiments, the processor (and/or co-processors or any other processing circuitry assisting or otherwise associated with the processor) may be in communication with the memory device via a bus for passing information among components of the apparatus. The memory device may be non-transitory and may include, for example, one or more volatile and/or non-volatile memories. In other words, for example, the memory device may be an electronic storage device (e.g., a computer readable storage medium) comprising gates configured to store data (e.g., bits) that may be retrievable by a machine (e.g., a computing device like the processor). The memory device may be configured to store information, data, content, applications, instructions, or the like for enabling the apparatus to carry out various functions in accordance with an example embodiment of the present invention. For example, the memory device could be configured to buffer input data for processing by the processor. Additionally or alternatively, the memory device could be configured to store instructions for execution by the processor.

As noted above, the apparatus 20 may be embodied by UE 10. However, in some embodiments, the apparatus may be embodied as a chip or chip set. In other words, the apparatus may comprise one or more physical packages (e.g., chips) including materials, components and/or wires on a structural assembly (e.g., a baseboard). The structural assembly may provide physical strength, conservation of size, and/or limitation of electrical interaction for component circuitry included thereon. The apparatus may therefore, in some cases, be configured to implement an embodiment of the present invention on a single chip or as a single “system on a chip.” As such, in some cases, a

chip or chipset may constitute means for performing one or more operations for providing the functionalities described herein.

The processor 22 may be embodied in a number of different ways. For example, the processor may be embodied as one or more of various hardware processing means such as a coprocessor, a microprocessor, a controller, a digital signal processor (DSP), a processing element with or without an accompanying DSP, or various other processing circuitry including integrated circuits such as, for example, an ASIC (application specific integrated circuit), an FPGA (field programmable gate array), a microcontroller unit (MCU), a hardware accelerator, a special-purpose computer chip, or the like. As such, in some embodiments, the processor may include one or more processing cores configured to perform independently. A multi-core processor may enable multiprocessing within a single physical package. Additionally or alternatively, the processor may include one or more processors configured in tandem via the bus to enable independent execution of instructions, pipelining and/or multithreading.

In an example embodiment, the processor 22 may be configured to execute instructions stored in the memory device 24 or otherwise accessible to the processor. Alternatively or additionally, the processor may be configured to execute hard coded functionality. As such, whether configured by hardware or software methods, or by a combination thereof, the processor may represent an entity (e.g., physically embodied in circuitry) capable of performing operations according to an embodiment of the present invention while configured accordingly. Thus, for example, when the processor is embodied as an ASIC, FPGA or the like, the processor may be specifically configured hardware for conducting the operations described herein. Alternatively, as another example, when the processor is embodied as an executor of software instructions, the instructions may specifically configure the processor to perform the algorithms and/or operations described herein when the instructions are executed. However, in some cases, the processor may be a processor of a specific device (e.g., a mobile terminal or a fixed computing device) configured to employ an embodiment of the present invention by further configuration of the processor by instructions for performing the algorithms and/or operations described herein. The processor may include, among other things, a clock, an arithmetic logic unit (ALU) and logic gates configured to support operation of the processor.

The apparatus 20 of an example embodiment may also include a communication interface 26 that may be any means such as a device or circuitry embodied in either hardware or a combination of hardware and software that is configured to receive and/or transmit data from/to a communications device in communication with the apparatus, such as to facilitate communications with one or more user equipment 10 or the like. In

this regard, the communication interface may include, for example, an antenna (or multiple antennas) and supporting hardware and/or software for enabling communications with a wireless communication network. Additionally or alternatively, the communication interface may include the circuitry for interacting with the antenna(s) to cause transmission of signals via the antenna(s) or to handle receipt of signals received via the antenna(s). In some environments, the communication interface may alternatively or also support wired communication. As such, for example, the communication interface may include a communication modem and/or other hardware and/or software for supporting communication via cable, digital subscriber line (DSL), universal serial bus (USB) or other mechanisms.

The apparatus 20 may also include a user interface 28 that may, in turn, be in communication with the processor 22 to provide output to the user and, in some embodiments, to receive an indication of a user input. As such, the user interface may include a display and, in some embodiments, may also include a keyboard, a mouse, a joystick, a touch screen, touch areas, soft keys, one or more microphones, a plurality of speakers, or other input/output mechanisms. In one embodiment, the processor may comprise user interface circuitry configured to control at least some functions of one or more user interface elements such as a display and, in some embodiments, a plurality of speakers, a ringer, one or more microphones and/or the like. The processor and/or user interface circuitry comprising the processor may be configured to control one or more functions of one or more user interface elements through computer program instructions (e.g., software and/or firmware) stored on a memory accessible to the processor (e.g., memory device 24, and/or the like).

Example Process for Adaptive Candidate List Population for WLAN Offloading

Referring now to Figure 3, the operations performed, such as by the apparatus 20 of Figure 2, for generating POI boundary data are illustrated. As shown in block 302 of Figure 3, the apparatus may include means, such as a processor 22, a communications interface 26, or the like, configured to receive server routing rules. The communications interface 26 may receive server routing rules form the cellular network, such as a 3GPP network. The server routing rules may be pre-provisioned to the apparatus 20, such as during attachment of the apparatus to a home network. In an example embodiment the server routing rules may be provisioned using an access network discovery and selection function (ANDSF). The use of an ANDSF may allow the cellular network 14 to update the server routing rules as necessary. Additionally or alternatively the communications interface 26 may receive the server routing rules from service provider as pre-provisioned

during manufacturing, point of sale, or from service provider using SOAP-XML instead of OMA-DM, or the like, .

As shown in block 304 of Figure 3, the apparatus 20 may include means, such as a processor 22, or the like, configured to generate an offload candidate list of applications and application traffic that may be offloaded to a WLAN 12. The offload candidate list may include applications, traffic streams associated with applications, access point names (APNs), destination and/or source addresses, port numbers (in internet protocol (IP) level), also in the form of quintuples of source/destination address, source/destination port and differentiated services traffic class, running in the apparatus 20.

As shown in block 306 of Figure 3, the apparatus 20 may include means, such as a processor 22, or the like, configured to determine if there are candidates for offloading to a WLAN 12. Based on the server routing rules, the processor 22 may determine if any of the offload candidates from the offload candidate list may be routed to a WLAN 12. The processor 22 may also check the validity conditions for WLAN 12. The processor 22 may evaluate the offload candidate list in response to WLAN 12 conductivity becoming available, a change in application status of an offload candidate, a change in application traffic status of an offload candidate, or the like. For example, the processor may evaluate the offload candidate list to determine if any of the offload candidates may be offloaded to a WLAN 12 in response to a new application being started, a change in application traffic, e.g. more or less traffic, or a new WLAN AP becoming available. In an instance in which one or more offload candidates have been determined for offloading to a WLAN 12, the process may continue at 312 activation of a WLAN transceiver associated with the apparatus 20. In an instance in which no offload candidates have been determined for offload to a WLAN 12, the process may continue at 308 determination if the WLAN transceiver associated with the apparatus is active.

As shown in block 308 of Figure 3, the apparatus 20 may include means, such as a processor 22, communications interface 26, or the like, configured to determine if the WLAN transceiver associated with the apparatus 20 is active. If the WLAN transceiver is active in an instance in which no offload candidate is determined for offloading to a WLAN, the processor may deactivate the WLAN transceiver at 310. Additionally or alternatively, the processor 22 may not deactivate the WLAN transceiver, in an instance in which the WLAN is being utilized for other services. In an instance in which the WLAN transceiver is not active the process may continue at 304 generation of an offload candidate list.

As shown in block 310 of Figure 3, the apparatus 20 may include means, such as a processor 22, a communications interface 26, or the like, configured to deactivate the WLAN transceiver associated with the apparatus 20. In an instance in which the

processor 22 determines that the WLAN transceiver is active and no offload candidate has been identified for offload to the WLAN 12, the processor 22 may deactivate the WLAN transceiver. As discussed at 308, the processor 22 may not deactivate the WLAN transceiver in an instance in which the WLAN is being utilized for other services. The process may continue at block 304 generation of the offload candidate list.

A shown in block 312 of Figure 3, the apparatus 20 may include means, such as a processor 22, a communications interface 26, or the like, configured to activate a WLAN transceiver associated with the apparatus. The processor 22 may determine if the WLAN is active and in an instance in which the WLAN is not active, activate the WLAN. If the WLAN is active or once the processor 22 has activated the WLAN the process continues at block 314 determine if there is a WLAN AP available from previous information.

As shown in block 314 of Figure 3, the apparatus 20 may include means such as a processor 22, a memory 24, or the like, configured to determine if there is a WLAN AP available from previous information. The processor 22 may use the server routing rules to determine if there is a WLAN AP in proximity which the apparatus knows through prior information. Prior information may include information derived from an active WLAN AP connection. In an example embodiment, the previous WLAN AP information may be retrieved from a memory 24, which may have been saved to the memory during a previous WLAN AP connection. In an instance in which a proximate WLAN AP in known, the process may continue at 320 connect to a WLAN AP. In an instance in which no proximate WLAN AP is known, the process may continue at 316 scan and fill a WLAN candidate list.

As shown in block 316 of Figure 3, the apparatus 20 may include means, such as a processor 22, a communications interface 26, or the like, configured to scan and fill a WLAN candidate list. The processor 22 may cause the communications interface 26 to scan for WLAN APs. The communications interface 26 may provide the processor with the proximate WLAN APs and associated information. The processor 22 may fill a WLAN candidate list with the information associated with the respective proximate WLAN APs.

As shown in block 318 of Figure 3, the apparatus 20 may include means, such as a processor 22, or the like, configured to prioritize WLAN candidate list. The processor 22 may prioritize the WLAN APs of the WLAN candidate list based on the server routing rules.

As shown in block 320 of Figure 3, the apparatus 20 may include means, such as a processor 22, a communications interface 26, or the like, configured to connect to a WLAN AP. In an instance in which a WLAN AP was known at 314, the processor 22 may connect to the known WLAN AP. In an instance in which there was not a known WLAN

AP at 314, the processor may connect to the highest priority WLAN AP of the WLAN candidate list.

As shown in block 322 of Figure 3, the apparatus 20 may include means, such as a processor 22, a communications interface 26, or the like, configured to route the identified offload candidates to the WLAN. The processor 22 may use the server routing rules to route the identified offload candidates to the WLAN 12. The process may continue at block 304 generating the offload candidate list. The processor 22 may continue to evaluate applications and application traffic for inclusion of the offload candidate list and/or WLAN offload periodically or based on changes in connectivity or application status, such as, starring new applications, application traffic status changes, or the like.

The activation and deactivation of the WLAN transceiver associated with the apparatus based on the offload candidate generation and determination significantly reduces processor power usage and consequently battery power usage, and allows for the processing power to be more effectively utilized and an increase in battery life.

As described above, Figures 3 illustrates a flowchart of an apparatus 20, method, and computer program product according to example embodiments of the invention. It will be understood that each block of the flowchart, and combinations of blocks in the flowchart, may be implemented by various means, such as hardware, firmware, processor, circuitry, and/or other communication devices associated with execution of software including one or more computer program instructions. For example, one or more of the procedures described above may be embodied by computer program instructions. In this regard, the computer program instructions which embody the procedures described above may be stored by a memory device 24 of an apparatus employing an embodiment of the present invention and executed by a processor 22 of the apparatus. As will be appreciated, any such computer program instructions may be loaded onto a computer or other programmable apparatus (e.g., hardware) to produce a machine, such that the resulting computer or other programmable apparatus implements the functions specified in the flowchart blocks. These computer program instructions may also be stored in a computer-readable memory that may direct a computer or other programmable apparatus to function in a particular manner, such that the instructions stored in the computer-readable memory produce an article of manufacture the execution of which implements the function specified in the flowchart blocks. The computer program instructions may also be loaded onto a computer or other programmable apparatus to cause a series of operations to be performed on the computer or other programmable apparatus to produce a computer-implemented process such that the

instructions which execute on the computer or other programmable apparatus provide operations for implementing the functions specified in the flowchart blocks.

Accordingly, blocks of the flowchart support combinations of means for performing the specified functions and combinations of operations for performing the specified functions for performing the specified functions. It will also be understood that one or more blocks of the flowchart, and combinations of blocks in the flowchart, can be implemented by special purpose hardware-based computer systems which perform the specified functions, or combinations of special purpose hardware and computer instructions.

In some embodiments, certain ones of the operations above may be modified or further amplified. Furthermore, in some embodiments, additional optional operations may be included, such as illustrated by the dashed outline of block 308, 310, 312, 314, 316, 318, and 320 in Figure 3. Modifications, additions, or amplifications to the operations above may be performed in any order and in any combination.

Many modifications and other embodiments of the inventions set forth herein will come to mind to one skilled in the art to which these inventions pertain having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the inventions are not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. Moreover, although the foregoing descriptions and the associated drawings describe example embodiments in the context of certain example combinations of elements and/or functions, it should be appreciated that different combinations of elements and/or functions may be provided by alternative embodiments without departing from the scope of the appended claims. In this regard, for example, different combinations of elements and/or functions than those explicitly described above are also contemplated as may be set forth in some of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

THAT WHICH IS CLAIMED:

1. A method comprising:

receiving routing rules;

generating an offload candidate list, wherein the offload candidate list comprises applications or application traffic,

determining offload candidates of the offload candidate list which can be routed to a wireless local area network (WLAN) based on the routing rules; and

routing at least one offload candidate from the offload candidate list to the WLAN.

2. The method of Claim 1 further comprising:

activating a WLAN transceiver in response to determining at least one of the offload candidates can be routed to the WLAN.

3. The method of Claim 1 further comprising:

determining if a WLAN access point (AP) is available based on the routing rules;

wherein if a WLAN AP is known the method further comprises

connecting to the WLAN AP;

wherein if a WLAN AP is not known, the method further comprises;

generating a WLAN candidate list, where in generating a WLAN access list comprises scanning for WLAN APs and filling the list with the WLAN AP information;

prioritizing the WLAN candidate list; and

connecting to the highest priority WLAN AP from the WLAN candidate list.

4. The method of Claim 1 further comprising:

deactivating a WLAN transceiver in response to determining none of the offload candidates can be routed to the WLAN.

5. The method of Claim 1, wherein the generating an offload candidate list is performed in response to changes in application status or application traffic status.

6. The method of Claim 1, wherein the routing rules are received using an access network discovery and selection function (ANDSF).

7. The method of Claim 1, wherein the application or application traffic comprises traffic through an access point name (APN), an active service, an active application, a traffic stream, or a traffic flow.

8. An apparatus comprising at least one processor and at least one memory including computer program code, the at least one memory and computer program code configured to, with the processor, cause the apparatus to at least:

receive routing rules;

generate an offload candidate list, wherein the offload candidate list comprises applications or application traffic,

determine offload candidates of the offload candidate list which can be routed to a wireless local area network (WLAN) based on the routing rules; and

route at least one offload candidate from the offload candidate list to the WLAN.

9. The apparatus of Claim 8, wherein the at least one memory and the computer program code are further configured to:

activate a WLAN transceiver in response to determining at least one of the offload candidates can be routed to the WLAN.

10. The apparatus of Claim 8, wherein the at least one memory and the computer program code are further configured to:

determine if a WLAN access point (AP) is available based on the routing rules;

wherein if a WLAN AP is known the at least one memory and the computer program code are further configured to;

connect to the WLAN AP;

wherein if a WLAN AP is not known, the at least one memory and the computer program code are further configured to;

generate a WLAN candidate list, where in generating a WLAN access list comprises scanning for WLAN APs and filling the list with the WLAN AP information;

prioritize the WLAN candidate list; and

connect to the highest priority WLAN AP from the WLAN candidate list.

11. The apparatus of Claim 8, wherein the at least one memory and the computer program code are further configured to:

deactivate a WLAN transceiver in response to determining none of the offload candidates can be routed to the WLAN.

12. The apparatus of Claim 8, wherein the generating an offload candidate list is performed in response to changes in application status or application traffic status.

13. The apparatus of Claim 8, wherein the routing rules are received using an access network discovery and selection function (ANDSF).

14. The apparatus of Claim 8, wherein the application or application traffic comprises traffic through an access point name (APN), an active service, an active application, a traffic stream, or a traffic flow.

15. A computer program product comprising at least one non-transitory computer-readable storage medium having computer-executable program portions stored therein, the computer-executable program code portions comprising program code instructions configured to:

receive routing rules;

generate an offload candidate list, wherein the offload candidate list comprises applications or application traffic,

determine offload candidates of the offload candidate list which can be routed to a wireless local area network (WLAN) based on the routing rules; and

route at least one offload candidate from the offload candidate list to the WLAN.

16. The computer program product of Claim 15, wherein the computer-executable program code portions further comprise program code instructions configured to:

activate a WLAN transceiver in response to determining at least one of the offload candidates can be routed to the WLAN.

17. The computer program product of Claim 15, wherein the computer-executable program code portions further comprise program code instructions configured to:

determine if a WLAN access point (AP) is available based on the routing rules;

wherein if a WLAN AP is known the computer-executable program code portions further comprise program code instructions configured to;

connect to the WLAN AP;

wherein if a WLAN AP is not known, the computer-executable program code portions further comprise program code instructions configured to;

generate a WLAN candidate list, where in generating a WLAN access list comprises scanning for WLAN APs and filling the list with the WLAN AP information;

prioritize the WLAN candidate list; and

connect to the highest priority WLAN AP from the WLAN candidate list.

18. The computer program product of Claim 15, wherein the computer-executable program code portions further comprise program code instructions configured to:

deactivating a WLAN transceiver in response to determining none of the offload candidates can be routed to the WLAN.

19. The computer program product of Claim 15, wherein the generating an offload candidate list is performed in response to changes in application status or application traffic status.

20. The computer program product of Claim 15, wherein the routing rules are received using an access network discovery and selection function (ANDSF).

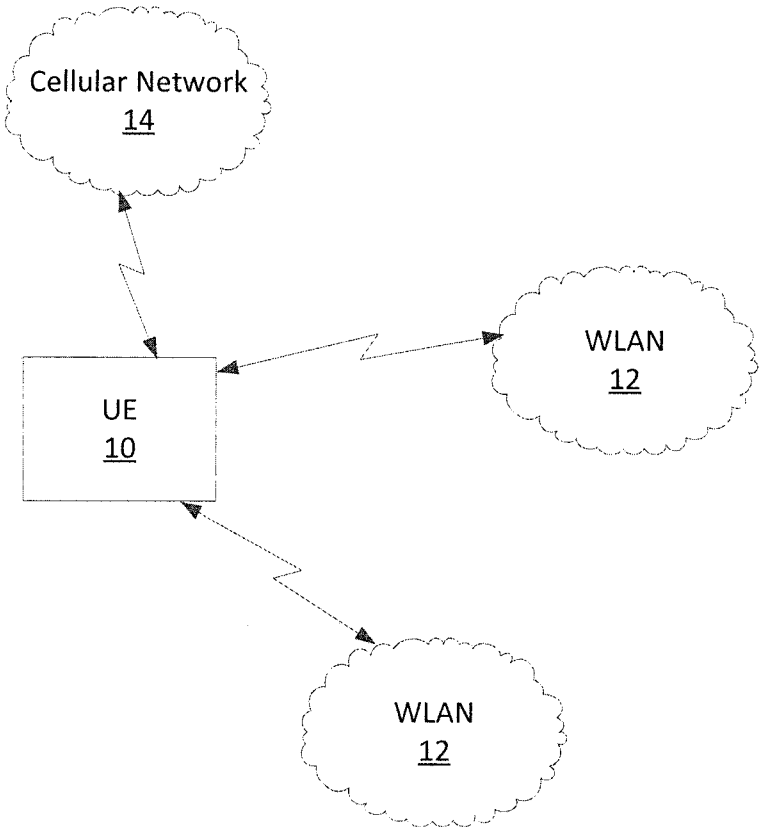


Figure 1

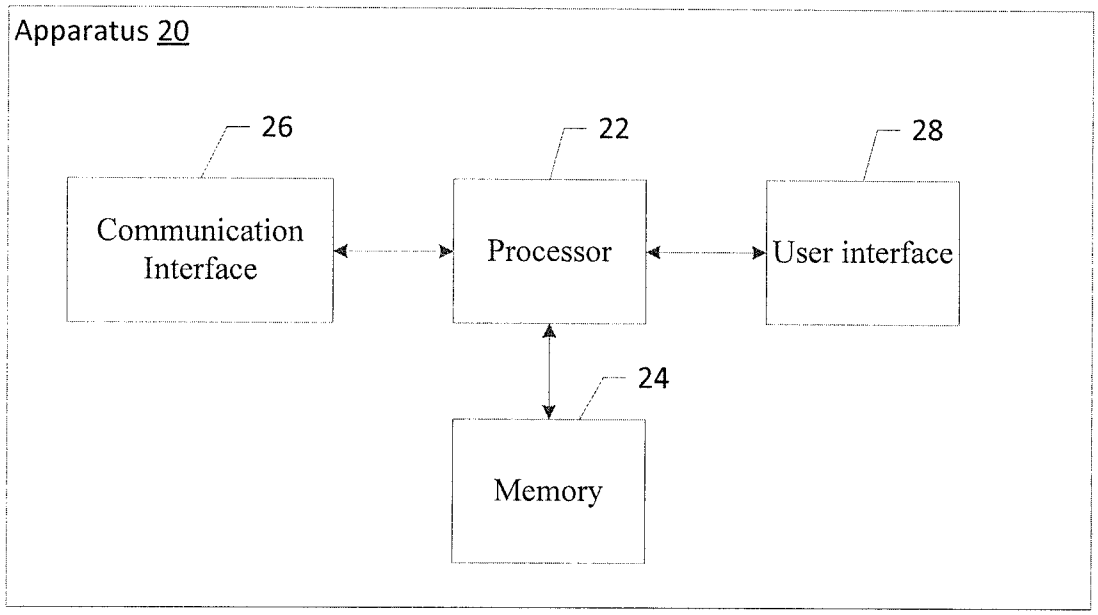

Apparatus 20
26
22
28
Communication Interface
Processor
User interface
24
Memory

Figure 2

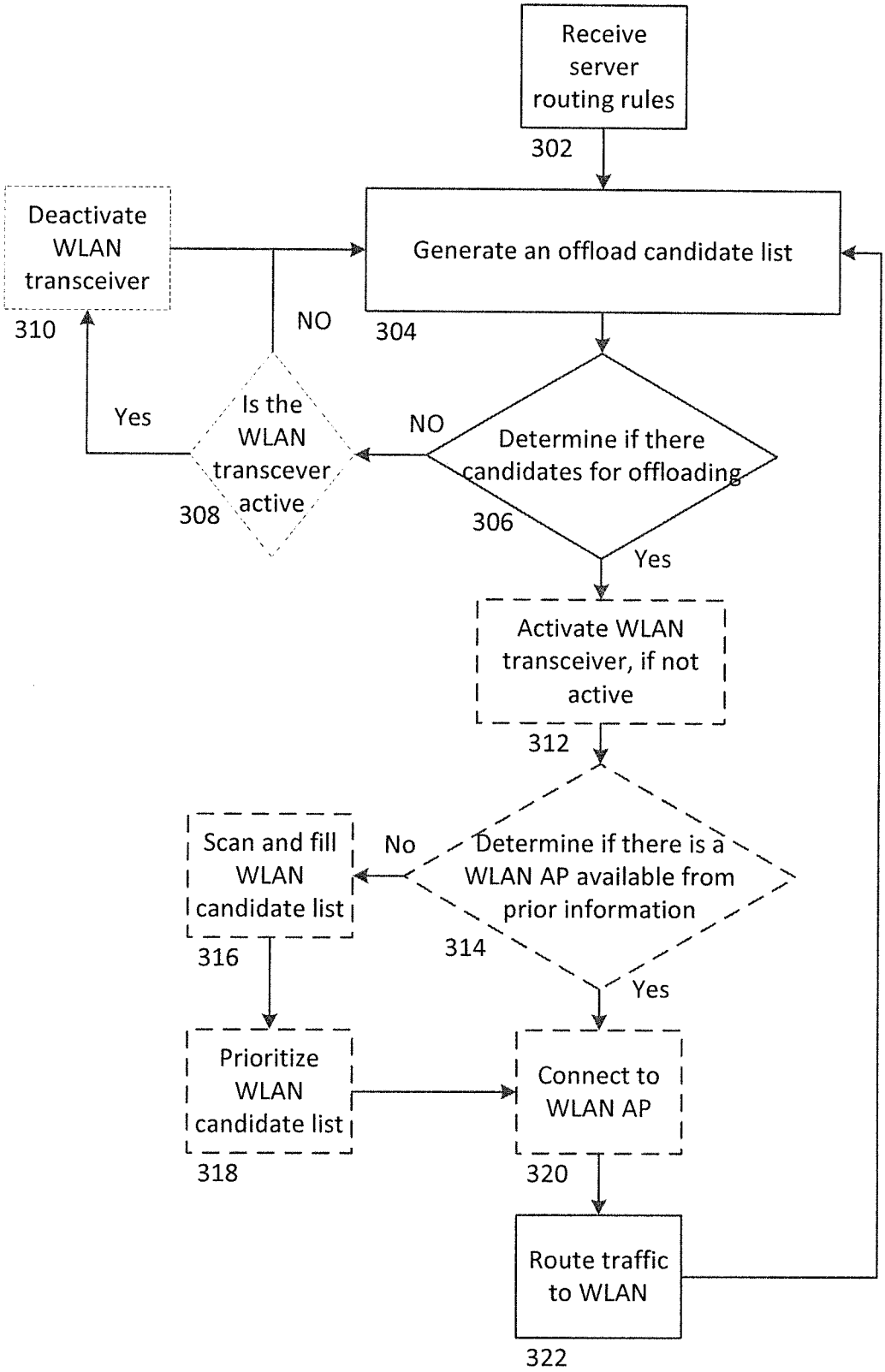

Receive server routing rules
302
Generate an offload candidate list
304
Determine if there candidates for offloading
306
NO
Yes
Is the WLAN transcever active
308
Yes
NO
Deactivate WLAN transceiver
310
Activate WLAN transceiver, if not active
312
Determine if there is a WLAN AP available from prior information
314
No
Yes
Scan and fill WLAN candidate list
316
Prioritize WLAN candidate list
318
Connect to WLAN AP
320
Route traffic to WLAN
322

Figure 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2014/060109

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: H04W

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

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, PAJ, WPI data, COMPENDEX, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2013022219 A1 (LG ELECTRONICS INC ET AL), 14 February 2013 (2013-02-14); abstract; paragraphs [0002], [0066]-[0071], [0109]-[0118]	1-2, 4-9, 11-16, 18-20
Y	--	3, 10, 17
Y	US 20140029420 A1 (JEONG SANGSOO ET AL), 30 January 2014 (2014-01-30); abstract; paragraphs [0008]-[0014], [0038], [0059], [0195]-[0198]	3, 10, 17
	--	
A	US 20140023041 A1 (ZHAO SULI ET AL), 23 January 2014 (2014-01-23); abstract	1-20
	--	

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28-11-2014	01-12-2014

Name and mailing address of the ISA/SE	Authorized officer
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International application No.
PCT/IB2014/060109

Continuation of: second sheet

International Patent Classification (IPC)

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H04W 40/00 (2009.01)
H04W 48/20 (2009.01)
H04W 84/12 (2009.01)

WO	2013022219	A1	14/02/2013	CN	103875263	A	18/06/2014
				CN	103843375	A	04/06/2014
				EP	2740284	A1	11/06/2014
				EP	2740285	A1	11/06/2014
				KR	20140046051	A	17/04/2014
				KR	20140046050	A	17/04/2014
				US	20140192651	A1	10/07/2014
				US	20140177446	A1	26/06/2014
				WO	2013022220	A1	14/02/2013
US	20140029420	A1	30/01/2014	WO	2014017855	A1	30/01/2014
US	20140023041	A1	23/01/2014	WO	2014018440	A1	30/01/2014