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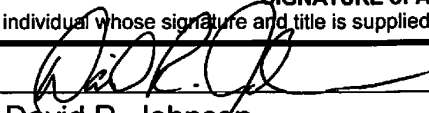
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ABSTRACT

Wireless offloading provides tools to a service provider to encourage or direct a subscriber to offload from a first network, e.g., a cellular network, to a second network, e.g., a Wi-Fi network. The cellular service provider can use network data to determine wireless offloading priorities for cellular subscribers on an individual or group basis. The cellular service provider may use wireless network data it has and/or wireless network data it learns about networks from the wireless devices (which may obtain Wi-Fi network data from beacon frames of Wi-Fi networks or active scanning and which may report to the cellular service provider). Each wireless device can be given scanning assignments to ensure that the reporting task is shared among subscribers or adjusted to fill in gaps in data. With the network data, the cellular service provider is capable of generating useful prioritized network lists for wireless devices, either individually or as a group. Preferences can be encouraged in the form of incentive offers to subscribers to, e.g., offload from the cellular network to a Wi-Fi network. Incentive offers can include offers to lower service costs or provide additional or improved services.

CLAIMS

1. A method comprising:
 - identifying one or more alternative wireless networks;
 - obtaining current performance data on the one or more alternative wireless networks;
 - obtaining historical performance data on the one or more alternative wireless networks from a network element;
 - characterizing the performance state of each of the one or more alternative wireless networks based on the current performance data and on the historical performance data;
 - applying rules involving the performance state characterization to determine whether to switch from a first wireless network to a particular wireless network of the one or more alternative wireless networks; and
 - switching an end user device from a first wireless network to the particular wireless network in response to the application of the rules.

SYSTEM AND METHOD FOR WIRELESS NETWORK OFFLOADING

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BACKGROUND

[0002] Wireless networks, such as Wi-Fi, 2G, 3G, 4G and WiMAX, whether governed by standards or proprietary protocols, often overlap with one another. Multiple wireless networks of the same type, perhaps with configuration-specific differences, also often overlap with one another.

[0003] A wireless device chooses an available wireless network to associate with. The choice is generally made based on user selection, whether or not a better selection is available for a given situation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] FIG. 1 depicts a diagram of an example of a system including a wireless network offloading engine.

[0005] FIG. 2 depicts a diagram of an example of a system for providing a prioritized network list to stations on a wireless network.

[0006] FIG. 3 depicts a diagram of an example of a system for generating temporally adjusted prioritized network lists.

[0007] FIG. 4 depicts a diagram of an example of a system for monitoring performance of networks on a prioritized network list.

[0008] FIG. 5 depicts a diagram of an example of a system for using a motion trace to prioritize networks on a network map.

[0009] FIG. 6 depicts a diagram of an example of a system for using knowledge of subscriber network connections to prioritize network lists for subscribers.

[0010] FIG. 7 depicts a diagram of an example of a system for using performance history to customize a prioritized network list.

[0011] FIG. 8 depicts a diagram of an example of a system for selecting network connections based on network prioritization.

[0012] FIG. 9 depicts a conceptual display associated with incentivized network selection.

[0013] FIG. 10 depicts a diagram of an example of a system for offering incentives to a subscriber to connect to a network.

[0014] FIG. 11 depicts a diagram of an example of a system for repeatedly cycling through performance tests.

[0015] FIG. 12 depicts a diagram of an example of a system capable of wireless network offloading.

[0016] FIG. 13 depicts an example of a computer system on which techniques described in this paper can be implemented.

[0017] FIG. 14 depicts a flowchart of an example of a method for prioritized wireless offloading.

[0020.1] FIG. 15 depicts a flowchart of an example of a method for using device assisted services to facilitate wireless offloading.

DETAILED DESCRIPTION

[0018] In the following description, several specific details are presented to provide a thorough understanding of embodiments of the invention. One skilled in the relevant art will recognize, however, that embodiments of the invention can be practiced without one or more of the specific details, or in combination with other components, etc. In other instances, well-known implementations or operations are not shown or described in detail to avoid obscuring aspects of various embodiments.

[0019] A technique for wireless offloading provides tools to a service provider to encourage or direct a subscriber to offload from a first network to a second network. For the purposes of this introductory example, the service provider may be referred to as a cellular service provider, the first network may be referred to as a cellular network, and the second network may be referred to as a Wi-Fi network.

[0020] The cellular service provider can use network data to determine wireless offloading priorities for cellular subscribers on an individual or group basis. In order to determine wireless offloading priorities, the cellular service provider may use wireless network data it has and/or wireless network data it learns about networks from the wireless devices (which may obtain Wi-Fi network data from beacon frames of Wi-Fi networks or active scanning and which may report to the cellular service provider). Each wireless device can be given scanning assignments to

ensure that the reporting task is shared among subscribers or adjusted to fill in gaps in data. With the network data, the cellular service provider is capable of generating useful prioritized network lists for wireless devices, either individually or as a group. These prioritized network lists can be represented as a network map.

[0021] The cellular service provider can obtain more than just network data. For example, wireless devices can provide connection data, such as the probability that an authentication request will result in an eventual connection or the delay in the access grant. The wireless device can timestamp certain data to enable the service provider to determine how network or otherwise relevant characteristics can vary by, for example, time of day or day of the week. Other data can include the location of the wireless device, which can provide data useful for determining zones of coverage for a service area with different performance or other characteristics. Using a combination of the timestamp and location data, the server can derive a motion trace, or the motion trace can be explicitly provided by subscribers, that is representative of the velocity at which a subscriber is moving. All of this data can be useful for generating more useful prioritized lists for the wireless devices.

[0022] The cellular service provider can also obtain subscriber-specific data. Some such data may be available from a subscriber account or the parameters of a service plan. Other such data can be in the form of user preferences or performance history for a wireless device. Rules for adjusting network priorities can take into account a cost function with parameters that may vary by implementation, configuration, or preference. Preferences can be encouraged in the form of incentive offers to subscribers to, e.g., offload from the cellular network to a Wi-Fi network. Incentive offers can include offers to lower service costs or provide additional or improved services.

[0023] FIG. 1 depicts a diagram of a system 100 including a wireless network offloading engine 106. The system 100 includes wireless devices 102-1 to 102-N (referred to collectively as the wireless devices 102), wireless networks 104-1 to 104-N (referred to collectively as the wireless networks 104), and a wireless network offloading engine 106.

[0024] The wireless devices 102 will at a minimum include a processor, memory (though the memory could be implemented in the processor), a radio, and a radio interface (though the radio interface could be implemented as “part of” the radio). The wireless devices 102 will typically have at least one input device and at least one output device, including input and output interfaces, if applicable.

[0025] The wireless devices 102 can be implemented as stations. A station, as used herein, may be referred to as a device with a media access control (MAC) address and a physical layer (PHY) interface to the wireless medium that comply with, e.g., the IEEE 802.11 standard. A station can be described as “IEEE 802.11-compliant” when compliance with the IEEE 802.11 standard is intended to be explicit (i.e., a device acts as described in at least a portion of the IEEE 802.11 standard.) One of ordinary skill in the relevant art would understand what the IEEE 802.11 standard comprises today and that the IEEE 802.11 standard can change over time, and would be expected to apply techniques described in this paper in compliance with future versions of the IEEE 802.11 standard if an applicable change is made. IEEE Std. 802.11™-2007 (Revision of IEEE Std. 802.11-1999) is incorporated by reference. IEEE 802.11k-2008, IEEE 802.11n-2009, IEEE 802.11p-2010, IEEE 802.11r-2008, IEEE 802.11w-2009, and IEEE 802.11y-2008 are also incorporated by reference.

[0026] In alternative embodiments, one or more of the wireless devices 102 may comply with some other standard or no standard at all, and may have different interfaces to a wireless or other medium. It should be noted that not all standards refer to wireless devices as “stations,” but where the term is used in this paper, it should be understood that an analogous unit will be present on all applicable wireless networks. Thus, use of the term “station” should not be construed as limiting the scope of an embodiment that describes wireless devices as stations to a standard that explicitly uses the term, unless such a limitation is appropriate in the context of the discussion.

[0027] The wireless networks 104 will typically include an internetworking unit (IWU) that interconnects wireless devices on the relevant one of the wireless networks 104 with another network, such as a wired LAN. The IWU is sometimes referred to as a wireless access point (WAP). In the IEEE 802.11 standard, a WAP is also defined as a station. Thus, a station can be

a non-WAP station or a WAP station. In a cellular network, the WAP is often referred to as a base station.

[0028] The wireless networks 104 can be implemented using any applicable technology, which can differ by network type or in other ways. The wireless networks 104 can be of any appropriate size (e.g., metropolitan area network (MAN), personal area network (PAN), etc.). Broadband wireless MANs may or may not be compliant with IEEE 802.16, which is incorporated by reference. Wireless PANs may or may not be compliant with IEEE 802.15, which is incorporated by reference. The wireless networks 104 can be identifiable by network type (e.g., 2G, 3G, 4G, and Wi-Fi), service provider, WAP/base station identifier (e.g., Wi-Fi SSID, base station and sector ID), geographic location, or other identification criteria.

[0029] The wireless networks 104 may or may not be coupled together via an intermediate network. The intermediate network can include practically any type of communications network, such as, by way of example but not limitation, the Internet, a public switched telephone network (PSTN), or an infrastructure network (e.g., private LAN). The term “Internet” as used herein refers to a network of networks which uses certain protocols, such as the TCP/IP protocol, and possibly other protocols such as the hypertext transfer protocol (HTTP) for hypertext markup language (HTML) documents that make up the World Wide Web (the web).

[0030] In the example of FIG. 1, the wireless network offloading engine 106 is coupled to the wireless device 102-1. In a specific implementation, the wireless network offloading engine 106 is implemented on a server and is coupled to the wireless device 102-1 through the Internet. However, at least a portion of the wireless network offloading engine 106, described in more detail later with reference to FIG. 2, can alternatively be implemented on the wireless device 102-1, with or without a connection to a server that includes another portion (e.g., a server portion) of the wireless network offloading engine 106.

[0031] In an example of operation, periodically, occasionally, or when instructed, the wireless device 102-1 performs an available network characterization scan (ANCS) on one or more of the wireless networks 104. Other devices, such as the wireless device 102-2 or some other station, may or may not also perform an ANCS. The ANCS can be used to characterize available

performance for each network (e.g., data rate, bit rate variability, latency, latency jitter, quality of service (QoS), response time, etc.).

[0032] Some objective criteria for measuring performance exist (e.g., throughput). Intelligent network monitoring can enable real-time monitoring of network service usage (e.g., at the packet level/layer, network stack application interface level/layer, and/or application level/layer) of the wireless network (e.g., radio access networks and/or core networks) and to effectively manage the network service usage for protecting network capacity (e.g., while still maintaining an acceptable user experience). Using Device Assisted Services (DAS) techniques, and in some cases, network assisted/based techniques, to provide for network service usage monitoring of devices, network carriers/operators would be provided greater insight into what devices, which users and what applications, and when and where network congestion problems occur, enabling operators to intelligently add additional resources to certain areas when necessary (e.g., offloading data traffic onto femto cells or WiFi hotspots and adding more network resources), to differentially control network service usage, and/or to differentially charge for network service usage based on, for example, a network busy state, for protecting network capacity.

[0033] Performance need not be based on network performance alone. For example, a subscriber may be interested in economic performance (e.g., price). Accordingly, in this paper, performance is sometimes characterized using a cost function that can include various parameters, including network performance, economic performance, reliability, and/or other parameters that are indicative of preferences of a user or service provider. Where a particular type of performance is applicable, the meaning can be made explicit (e.g., by making reference to “network performance” as opposed to simply “performance”) or can be derived from context.

[0034] The wireless device 102-1 generates an ANCS report using results of the ANCS in order to characterize available performance for each scanned network of the wireless networks 104. The ANCS report can also include an identification of currently available networks for the wireless device 102-1, location, time, and potentially some performance characterization. The wireless device 102-1 makes the ANCS report available to the wireless network offloading engine 106. The wireless device 102-1 can also make device-specific information available, such as location, performance thresholds, a motion trace, knowledge about other devices or

interference, a performance history, applications (e.g., a VoIP or streaming media application), device-specific rules related to when the device will link to a network or offload (e.g., based on reliability, performance state, congestion state, QoS, incentive state, et al.), or a cost function (e.g., based on signal strength, channel strength, basic radio bit rate, network speed, network throughput, speed jitter, throughput jitter, network delay, delay jitter, network availability, network reliability in access grant percentage, network reliability in delay in access grant, variation in performance as a function of position, et al.). Alternatively, some device-specific information may or may not be shared with the wireless network offloading engine 106, and used to customize a priority list or multi-dimensional network map that is generated or received at the wireless device 102-1.

[0035] The wireless network offloading engine 106 generates a multi-dimensional network map from the ANCS report and/or other data that is known to the wireless network offloading engine 106. The wireless network offloading engine 106 can provide the multi-dimensional network map to the wireless device 102-1, from which the wireless device 102-1 *can* generate or modify a wireless operation instruction set. Alternatively, the wireless network offloading engine 106 can generate an instruction set from the multi-dimensional map, which it makes available to the wireless device 102. The instruction set can be an implementation of a general algorithm that is customized by the wireless device 102-1 after it is received, or the instruction set can be generated specifically for the wireless device 102-1 or a set of devices that includes the wireless device 102-1, to be executed on-device in accordance with device-specific parameters (e.g., power saving settings, location, time of day, etc.). Advantageously, the wireless device 102-1 is able to use the instruction set to enable intelligent offloading of the wireless device 102-1 from one of the wireless networks 104 to another. In some embodiments, the wireless device 102-1 is capable of modifying the multi-dimensional network map before making a network selection decision. The wireless network offloading engine may provide one or more parameters and/or algorithms to the wireless device 102-1 for making the network selection decision.

[0036] Differential network access control for protecting network capacity includes applying policies to determine which network a service activity should be connected to (e.g., 2G, 3G, 4G, home or roaming, WiFi, cable, DSL, fiber, wired WAN, and/or another wired or wireless or

access network), and applying differential network access control rules (e.g., traffic control rules) depending on which network to which the service activity is connected. In some embodiments, differential network access control for protecting network capacity includes differentially controlling network service usage activities based on the service usage control policy and a user input (e.g., a user selection or user preference). Depending upon the implementation, network service usage control policy can consider availability of alternative networks, policy rules for selecting alternative networks, network busy state or availability state for alternative networks, specific network selection or preference policies for a given network service activity or set of network service activities, to name several.

[0037] In a specific implementation, the wireless device 102 aids in determining (e.g., measuring and/or characterizing) a network busy state experienced by the device (e.g., which can be used to determine the network access control policy for one or more network capacity controlled services). For example, the network busy state experienced by the device can be recorded by the device and included in a network busy state report that is sent to a network element/function (e.g., a wireless network offloading engine 106 as described herein). The network busy state report can include, for example, data rate, average throughput, minimum throughput, throughput jitter, latency, latency jitter, bit error rate, data error rate, packet error rate, packet drop rate, number of access attempts, number of access successes, number of access failures, QoS level availability, QoS level performance, variability in any of the preceding parameters, and/or the historic statistics of any of the preceding parameters, to name several by way of example. The network busy state report can include, for example, 2G, 3G, 4G or WiFi base station ID, SSID, cell sector ID, CDMA ID, FDMA channel ID, TDMA channel ID, GPS location, and/or physical location to identify the edge network element that is associated with the network busy state report to a network element, to name several by way of example. In a specific implementation, the network busy state is monitored by one or more network elements that can measure and/or report network busy state (e.g., wireless network offloading engine 106, BTS, BTSC, access point, base station monitor, and/or airwave monitor).

[0038] As a clarifying example embodiment, the wireless device 102 (e.g. a network performance characterization software or hardware agent on the device) acts in conjunction with a network element (e.g. a wireless network offloading engine 106) to characterize the network

busy state of an alternative network access point or base station resource. In such embodiments the device can sense an available alternative network, connect to a network element (e.g. a wireless network offloading engine 106) through the alternative network, conduct a download and/or upload sequence during which the network performance is monitored, and then cause the performance to be characterized and recorded. The performance can be characterized by the network element (e.g. a wireless network offloading engine 106), by the wireless device 102 (e.g. a network performance characterization software or hardware agent) or by both.

[0039] As another clarifying embodiment, the wireless device 102 (e.g. a network performance characterization software or hardware agent on the device) can sense an available alternative network, connect to the alternative network, allow the user to use the network connection services, monitor the resulting network performance and record the performance results.

[0040] In a specific implementation, one or more of the wireless devices that use wireless services on the one or more main networks and/or alternative networks are used as described herein to collect alternative network performance, busy state and/or QoS state information.

[0041] In a specific implementation, the main networks and/or alternative networks can be monitored and characterized by devices that are permanently located in the vicinity of one or more alternative network base stations or access points and configured to communicate with a wireless network offloading engine 106. A permanently located mobile terminal can provide network monitors for reporting, for example, network busy state, to a central network element, such as the wireless network offloading engine 106, which can, for example, aggregate such network busy state information to determine network busy state for one or more network coverage areas.

[0042] For example, airwave monitors and/or base station monitors can be provided to facilitate a reliable characterization of network busy state in a coverage area of one or more base stations and/or base station sectors and/or WiFi access points, such as affixed mobile terminals (e.g., trusted terminals that can include additional network busy state monitoring and/or reporting functionality) installed (e.g., temporarily or permanently) in the coverage area of one or more base stations and/or base station sectors (e.g., in which a sector is the combination of a

directional antenna and a frequency channel) so that the mobile terminals perform network busy state monitoring and reporting to the wireless network offloading engine 106, the local base station, and/or other network element(s)/function(s). In some embodiments, the permanently affixed mobile terminals provide network monitors for reporting, for example, network busy state (or performance, reliability or QoS), to a central network element, such as the wireless network offloading engine 106, which can, for example, aggregate such network busy state information to determine network busy state for one or more network coverage areas. In some embodiments, the mobile terminals are always present in these locations where installed and always on (e.g., performing network monitoring), and can be trusted (e.g., the mobile terminals can be loaded with various hardware and/or software credentials). For example, using the mobile terminals, a reliable characterization of network busy state can be provided, which can then be reported to a central network element and aggregated for performing various network busy state related techniques as described herein with respect to various embodiments.

[0043] In a specific implementation, the wireless network offloading engine 106 uses the network busy state reports (or performance reports or QoS reports) from user devices and/or permanent mobile terminals connected to the same alternative network to determine the network busy state for an alternative network edge element connected to the device.

[0044] In some embodiments, a network element/function (e.g. a wireless access point or base station) sends a busy state report for the network edge element to the device (e.g., and to other devices connected to the same network edge element), which the device can then use to implement differential network access control policies (e.g., for network capacity controlled services) based on the network busy state. In some embodiments, a network busy state is provided by a network element (e.g., wireless network offloading engine 106 or service cloud) and broadcast to the device (e.g., securely communicated to the wireless device 102).

[0045] In some embodiments, the wireless device 102 (e.g. a network performance characterization software or hardware agent) selects the access network connection in accordance with a network service profile setting that determines which network the device should choose between available alternative WWAN, WLAN, WPAN, Ethernet and/or DSL network connections. This choice can be based on the performance, reliability, busy state or

QoS capability of one or more alternative networks. The characterization of the alternative networks can be based on an end to end performance, and not just the over the air or radio frequency performance. For example, service profile settings can be based on the performance of the actual access network (e.g., home DSL/cable, coffee shop, shopping center, public WiFi hot spot or work network) behind the Wi-Fi not the fact that it is Wi-Fi (e.g., or any other network, such as DSL/cable, satellite, or T-1), which is viewed as different than accessing a Wi-Fi network at the coffee shop. For example, in a Wi-Fi hotspot situation in which there are a significant number of users on a DSL or T-1 backhaul, the wireless network offloading engine 106 can sit in a service provider cloud or an MVNO cloud, the service controls can be provided by a VSP capability offered by the service provider or the wireless network offloading engine 106 can be owned by the hotspot service provider that uses the wireless network offloading engine 106 on their own without any association with an access network service provider.

[0046] FIG. 2 depicts a diagram an example of a system 200 for providing a prioritized network list to stations on a wireless network. In the example of FIG. 2, the system 200 includes a network 202, a point-of-presence (PoP) 204, a network switch 206, wireless networks 208-1 to 208-N (collectively referred to as wireless networks 208), and a communications service provider (CSP) 210. The wireless network 208-1 includes a WAP 212 and, in operation, stations 214-1 to 214-N (collectively referred to as stations 214). The CSP 210 includes a prioritized network list provisioning engine 216.

[0047] The network 202 can include any applicable network that is capable of coupling the station 214-1 to the CSP 210. The PoP 204 is coupled to the network 202. The term “PoP” is often used to refer to a PoP on the Internet. However, the term as used with reference to FIG. 2 is intended to mean a PoP on the network 202, regardless of the type of network. The network switch 206 can be referred to as a wireless network switch because it couples the WAP 212 to a (typically) wired network, such as a LAN. The term “WAP” is often used with reference to AP stations in an IEEE 802.11-compatible network. However, the term should be construed to include the relevant node when the wireless network makes use of some other access technology (e.g., the term “base station” is often used to refer to the access node of a cellular network). In some cases, one or more of the PoP 204, network switch 206, and WAP 212 can be co-located.

[0048] The wireless networks 208 can be of an applicable known or convenient wireless network type. The basic service set (BSS) is a term used in IEEE 802.11 to refer to a group of stations that communicate with one another. The basic service area is defined by the propagation characteristics of the wireless medium. (Note: the term “area” is typically used to describe the three-dimensional space of a basic service area.) A station in the basic service area can communicate with other stations in the BSS. A BSS with a WAP, as is depicted in the example of FIG. 2 for the wireless network 208-1, can be referred to as an infrastructure BSS. To avoid confusion with the acronym IBSS, which refers to an independent BSS (also known as an *ad hoc* BSS), an infrastructure BSS is not referred to as an IBSS. An infrastructure BSS is defined by the distance from the WAP; so the stations 214, which are all on the wireless network 208-1, are within reach of the WAP 212 (as illustrated by the stations 214 being depicted as inside the cloud associated with the wireless network 208-1). In an infrastructure BSS, stations must associate with a WAP to obtain network services. The stations typically initiate the process and the WAP decides whether to grant or deny access based on the contents of an association request. Although this process is described in the context of IEEE 802.11 language, a similar description is applicable to other wireless network technologies.

[0049] The wireless network 208-1 is constrained in size by the range of the WAP 212, though multiple WAPs (not shown) could be used to increase the size of the wireless network 208-1. An extended service set (ESS) can comprise multiple BSSs, each connected to a backbone network. All of the WAPs in an ESS are given the same service set identifier (SSID), which is can be considered to be the “name” of the wireless network. The degree to which basic service areas overlap in an extended service area is implementation- and/or technology-specific.

[0050] The WAP 212 may or may not support multiple wireless networks with the same radio. Within the WAP 212, each SSID would be associated with a virtual LAN (VLAN). A relatively common implementation of this is when the WAP 212 supports a guest network (a first VLAN) and an internal network (a second VLAN). The stations 214 would likely see two separate networks in the radio domain. Thus, the wireless networks 208 may or may not have separate WAPs. A WAP that supports multiple networks may or may not have the same range for each network, particularly if the broadcast power or frequency bands are different (e.g., a WAP could be 802.11a and 802.11b/g-compatible).

[0051] In the example of FIG. 2, the stations 214 are within a service area of the wireless networks 208. As is shown by way of example, some of the stations, e.g., station 214-N, can be within the service area of a different wireless network, e.g., wireless network 208-N, than the other stations 214. The stations 214 can send information about a subset of the wireless networks 208 if the stations 214 are in the respective service areas of the wireless networks 208. By subset, it is intended that, depending upon the implementation or station capabilities, a station may or may not send information about all of the wireless networks 208 if in the respective service areas, and may or may not send information about any of the wireless networks 208. Depending upon the implementation or station capabilities, a station may or may not send information about a network when no longer in a service area of the wireless network, such as, e.g., when a WAP fails or the station is moved out of the service area. As shown by way of example, the station 214-1 is in the service area of wireless networks 208-1 and 208-2. So the station 214-1 can send information about the wireless networks 208-1 and 208-2, either the wireless network 208-1 or the wireless network 208-2, or neither of the wireless networks 208-1 and 208-2; the station 214-1 may or may not also send information about the wireless network 208-N, e.g., based on historical data, data received from station 214-N, or data received from another source, even though the station 214-1 is not currently within the service area of the wireless network 208-N.

[0052] The stations 214 are operationally connected to the CSP 210 through the WAP 212. Where the CSP 210 is part of an enterprise network that includes the wireless network 208-1, the stations 214 may or may not actually be coupled to the CSP 210 through the PoP 204 because the CSP 210 could be on the wired backbone network to which the WAP 212 is connected. However, this observation does not make an understanding of the example of FIG. 2 difficult to one of ordinary skill in the relevant art.

[0053] The CSP 210 can be part of a public or private entity in, e.g., telecom (landline or wireless), Internet, cable, satellite, and/or managed services businesses. CSPs often specialize in an industry, such as telecommunications, entertainment and media, and Internet/Web services, though service providers can operate in multiple areas. While it is likely that a CSP would be able to best implement the prioritized network list provisioning engine 216 due to the data available to the CSP, it is also possible to offer the prioritized network list provisioning engine

216 through an application service provider (ASP), if the ASP is given sufficient data either from stations or CSPs, or perhaps a managed service provider (MSP) providing services on behalf of the CSP or some other entity. Alternatively, the prioritized network list provisioning engine 216 could be implemented on a private network, or on some other server.

[0054] In the example of FIG. 2, it is assumed that the stations 214 are known to the CSP 210. If the CSP 210 provides services to each of the stations 214, the CSP 210 can have account information associated with each of the stations 214, can be made aware of device-specific data (e.g., roaming, bandwidth consumption, application use, etc.), and can receive additional information associated with the stations 214 and/or networks near the stations 214 over time. How the stations 214 are known and what information is made available to the CSP 210 can depend upon the implementation. For example, the CSP 210 could be controlled by a mobile wireless communication company that provides cellular services to the stations 214 on, e.g., a 4G network. (As was previously mentioned, some services could be provided through an ASP; so it should be borne in mind that this is simply one example and other applicable implementations should be understood to have appropriate variations.)

[0055] In the example of FIG. 2, the prioritized network list provisioning engine 216 provides a prioritized network list to the stations 214, which is represented in the example of FIG. 2 as a dashed line 218. The list need not be identical for each of the stations 214. For example, the prioritized network list provisioning engine 216 could customize the list sent to the station 214-1 based upon account parameters, current device-specific parameters, or historical device-specific parameters. Alternatively, the list sent to each of the stations 214 could be customized (or not) at the stations 214.

[0056] The prioritized list can be provided through an applicable channel. For example, the prioritized network list provisioning engine 216 could push the prioritized list to a station through a cellular network provided by a company that controls the CSP 210, through a public network out of the control of the company, through a private network, or through some other channel. The station could also pull the prioritized list from the prioritized network list provisioning engine 216. While it is likely the prioritized list will be provided on a wireless network periodically or as needed, it is also possible to provide the prioritized list in advance,

which means it could be, for example, provided when a wireless device is wire-connected to a computer that has been provided or can obtain the prioritized list.

[0057] Advantageously, the prioritized list can include information that is not available to the stations 214 at a given point in time. For example, the stations 214 can perform a passive scan of nearby network service areas. The stations 214 can sort the list of applicable wireless networks based on, for example, a received signal strength indicator (RSSI) for each of the wireless networks. This type of list is referred to in this paper as a “sorted list,” which is intended to mean a list that has been sorted in accordance with a current key value. However, certain data is not used when sorting the list of wireless networks. The certain data can be categorized as “historical data,” which is previously obtained data about characteristics of a subset of the wireless networks, and “remotely obtained data,” which is data of which one or more of the stations 214 did not collect on their own. (Data collected by a station can be referred to as “locally obtained data.”) A “prioritized list” is defined as a sorted list that is further sorted using historical and/or remotely obtained data. Where it is desirable to explicitly indicate the type of prioritized list, the prioritized list can be referred to as a historically and contemporaneously prioritized list, a remotely and locally prioritized list, or (where both types of data are used to create the prioritized list) a historically and contemporaneously, remotely and locally prioritized list. A prioritized list that can include any of these types is referred to as a “prioritized list.” Advantageously, the stations 214 can use a prioritized list that is provided from the prioritized network list provisioning engine 216 to guide network association behavior.

[0058] The stations 214 can obtain data by scanning. Passive scans can identify wireless networks that use beacon frames, which will include some information about the wireless network. Active scans can generally obtain more data than a passive scan. The data obtained can be used to modify the prioritized list. In an embodiment in which a station can generate its own prioritized list (in addition to or instead of receiving the prioritized list from the prioritized network list provisioning engine 216 on the CSP 210, for example) the station will use historical data accumulated with scans, and additional historical and/or remotely obtained data could be provided from a server or other source.

[0059] In an example in which the stations 214 are serviced by the CSP 210 or other communication service provider, the CSP 210 can optimize capacity for the stations 214 as a group. Capacity for the stations 214 can be optimized for the stations as a group by the CSP 210 having information about the networks 208 and deciding a prioritized list for each of the stations 214 that results in the stations 214 choosing to associate with the networks 208 such that the stations 214 have, in the aggregate, greater performance. The CSP 210 can take into account network loading on the networks 208 when generating the prioritized lists provided by the prioritized network list provisioning engine 216 to the stations 214. In this way, the CSP 210 can determine which of the networks 208 have more available bandwidth, and can optionally determine what the loading of the networks 208 will be after the stations 214 make use of the prioritized lists. Advantageously, the CSP 210 can use the current network load to predict load on the networks 208 based upon data provided by the stations, historical data, and prioritized lists that have not yet been sent. The CSP 210 can also consider station-specific data, such as applications that are being used, QoS requirements, historical bandwidth consumption, a cost function, etc., when determining how to generate the prioritized lists.

[0060] The stations 214 can have a network optimization engine (not shown) in which an algorithm is implemented to optimize capacity. The network optimization engine can reorganize a prioritized list based upon device-specific parameters and/or user preferences.

[0061] FIG. 3 depicts a diagram of an example of a system 300 for generating temporally adjusted prioritized network lists. In the example of FIG. 3, the system 300 includes a network interface 302, a network statistics datastore 304, a network statistics characterization engine 306, a subscriber datastore 308, a subscriber-specific characterization engine 310, a temporal adjustment engine 312, and a prioritized network list generation engine 314.

[0062] The network interface 302 is intended to include an applicable known or convenient interface to a network. The network interface 302 can have a variety of implementations, including a network interface card (NIC), a modem, or some other technology that facilitates interconnection with a network.

[0063] The network statistics datastore 304, and other datastores described in this paper, can be implemented, for example, as software embodied in a physical computer-readable medium on a general-purpose or specific-purpose machine, in firmware, in hardware, in a combination thereof, or in an applicable known or convenient device or system. Datastores in this paper are intended to include any organization of data, including tables, comma-separated values (CSV) files, traditional databases (e.g., SQL), or other applicable known or convenient organizational formats. Datastore-associated components, such as database interfaces, can be considered “part of” a datastore, part of some other system component, or a combination thereof, though the physical location and other characteristics of datastore-associated components is not critical for an understanding of the techniques described in this paper.

[0064] The network statistics datastore 304 can store network statistics data structures. As used in this paper, a data structure is associated with a particular way of storing and organizing data in a computer so that it can be used efficiently within a given context. Data structures are generally based on the ability of a computer to fetch and store data at any place in its memory, specified by an address, a bit string that can be itself stored in memory and manipulated by the program. Thus some data structures are based on computing the addresses of data items with arithmetic operations; while other data structures are based on storing addresses of data items within the structure itself. Many data structures use both principles, sometimes combined in non-trivial ways. The implementation of a data structure usually entails writing a set of procedures that create and manipulate instances of that structure.

[0065] The network statistics datastore 304 can store data structures having data that is received or derived from stations on a network. The amount of data that a station can obtain and provide to the system 300 will depend upon the capabilities of the station, the type of network, device-specific settings (e.g., active scan settings), and other factors. Data can include such values as RSSI, channel strength, basic radio bit rate, loading, network speed, network throughput, speed jitter, throughput jitter, network delay, delay jitter, network availability, successful network access grant, delay in access grant, location, to name several. The network statistics datastore 304 can store data from a plurality of stations to create a store of remotely obtained data. Over time, the network statistics datastore 304 can obtain a large store of historical data.

[0066] The network statistics characterization engine 306 can use network statistics to characterize networks. For example, the network statistics characterization engine 306 can, e.g., analyze location and RSSI for stations to determine a variation in performance as a function of position, analyze access grant data to determine an access grant likelihood, analyze number of stations associated to a network, applications in use at the stations, and the capacity of a network to determine available capacity for the network, or the like. Thus, the network statistics characterization engine 306 can take standard network measurements, combine the network measurements with historical network data and network data that is remotely obtained relative to a particular station, and transform the network statistics into a more useful form. Characterized network statistic data structures can be stored in the network statistics datastore 304 (an arrow indicating such storage is not shown in the example of FIG. 3 in order to avoid disrupting the illustrative flow).

[0067] Where the system 300 is on a private network managed by a service provider (e.g., a mobile service provider), subscribers will typically have an account. The subscriber datastore 308 can store account data structures (or subscriber data structures). Advantageously, the account data structures can include data that is useful for generating prioritized lists. For example, an account could include cost function parameters that are indicative of when a subscriber would wish to offload from one network to another. Such data can be used to customize a prioritized network list for a particular subscriber. As another example, an account could include performance or favored network preferences that enable prioritizing networks based upon subscriber preferences. As another example, the subscriber datastore 308 could include a motion trace useful to predict movement between coverage areas. It should be noted that some or all of the contents of the subscriber datastore 308 could instead be stored on a device, and a prioritized list could be customized based on the device-specific settings, movement (e.g., the motion trace), or the environment.

[0068] The subscriber-specific characterization engine 310 can use subscriber-specific data to modify network list priorities. For example, a subscriber can indicate what applications are used on a mobile device. The subscriber-specific characterization engine 310 can determine from the applications which networks are more desirable given the operational parameters of the application.

[0069] As another example, if a motion trace suggests that a subscriber is on a train because it is moving relatively fast, the subscriber-specific characterization engine 310 may strongly prioritize a cellular network over a shorter-range network (e.g., Wi-Fi). By “relatively fast,” what is meant is that the subscriber is moving at a rate that suggests hand-off from one network to another will be required with relatively high probability due to the subscriber's motion. It is possible for a motion trace to show relatively high velocity, but relatively low risk of hand-off (e.g., if a subscriber is riding a carousel). Hand-off from one access point of a network to another access point of the same network is likely not as large a concern as hand-off from one network type (e.g., Wi-Fi) to another network type (e.g., cellular) or from two different networks of the same type (e.g., a first private Wi-Fi network and a second private Wi-Fi network). The motion trace itself can be considered a subscriber-specific characterization in the sense that the subscriber datastore 308 can receive location data from, e.g., a mobile device of the subscriber, and the subscriber-specific characterization engine 310 can determine velocity from the change in location over time to establish that a subscriber is moving relatively fast.

[0070] The temporal adjustment engine 312 can adjust network priorities based on, e.g., time of day. For example, if the networks statistics datastore 304 has historical data that shows certain networks have high loads at certain times of day, the temporal adjustment engine 312 can prioritize networks that have lower loads in the near future. The temporal adjustment engine 312 can also change priorities using data from the subscriber datastore 308. For example, if a subscriber indicates they have a preference for not switching networks once associated, the temporal adjustment engine 312 can use subscriber historical activity to determine a likely amount of time the subscriber will be connected to a network and network historical data to determine likely loads on various networks during that time, and prioritize networks such that the subscriber can be connected to a network that will meet minimal performance preferences for the duration of the connection.

[0071] To the extent the subscriber datastore 308 is on a client device, the temporal adjustment engine 312 could provide priorities based upon time, and the client device could customize the prioritized network list. In an alternative implementation, the temporal adjustment engine 312 is on the client device and the client device receives prioritized lists that are different at different

times, then the temporal adjustment engine 312 customizes (or picks the appropriate) prioritized list based upon the current time.

[0072] The prioritized network list generation engine 314 generates a network list in accordance with the network statistics characterization engine 306 and, if applicable, the subscriber-specific characterization engine 310 and temporal adjustment engine 312. The prioritized network list can be provided to devices through the network interface 302.

[0073] Advantageously, the system 300 can characterize the statistics of available capacity for a network and determine how much if any reliable capacity is typically available on that network. This is accomplished by having devices report network data, e.g., how many devices are connected to the network, and prioritizes the network such that one or more devices will connect to or disconnect from the network based on an algorithm to optimize the (e.g., average, worst case, median, etc.) capacity offered to a group of devices serviced by the system 300. The algorithm can take into account loading of one or more alternative networks before sending the prioritized network list or otherwise communicating with a device to connect to or disconnect from the network. The system 300 can thereby characterize statistics of available capacity and provide prioritized network lists with reliable capacity as a function of time to adjust an available capacity factor. This technique is applicable to one or more devices optimized in the aggregate.

[0074] FIG. 4 depicts a diagram of an example of a system 400 for monitoring performance of prioritized network lists. In the example of FIG. 4, the system 400 includes a radio interface 402, a radio 404, a geo-location engine 406, a geo-prioritized networks datastore 408, a geo-analysis connection engine 410, a performance threshold datastore 412, a selective network monitoring engine 414, and an ANCS reporting engine 416.

[0075] In the example of FIG. 4, the radio interface 402 includes applicable known or convenient technology sufficient to enable a wireless device to use a radio to connect to a wireless network. Devices that use something other than a radio are theoretically possible; the term “radio interface” is used with the understanding that the communication device may or may not be limited to a specific subset of the electromagnetic (EM) spectrum, i.e., radio waves. The

radio interface 402 can include multiple interfaces for use with multiple radios and/or different radio frequencies or wireless protocols.

[0076] In the example of FIG. 4, the radio interface 402 is coupled to a radio 404. The radio 404 can include multiple radios for use with different radio frequencies or wireless protocols. For illustrative simplicity, the radio 404 will generally be treated as if operating consistently over one channel (potentially with multiple subchannels). In an alternative, the radio 404 can send reports or scan on one frequency, and send/receive other communications on another frequency.

[0077] In the example of FIG. 4, the geo-location engine 406 receives a prioritized list and modifies the list using device location. The geo-location engine 406 can use location to determine what networks should be included on the network list and what priorities of the networks should be. In a specific implementation, the geo-location engine 406 can be used in conjunction with a server that sends a geo-prioritized list that the geo-location engine 406 customizes at the device. For example, the server could send a geo-prioritized list for a geographical area that the geo-location engine 406 can adjust or use in accordance with current device location and/or a motion trace. Geo-prioritization can be in accordance with a cost function, where parameters of the cost function vary depending upon location (e.g., network performance can vary as a function of position).

[0078] In an alternative, the geo-location engine 406 could be implemented on a server, and used to generate geo-prioritized network lists for provisioning to subscribers. Using known locations of devices, the server can, depending upon the implementation, send a geo-prioritized network list for a local geographical area near the device or for geographical areas that have historically been frequented by the device.

[0079] In the example of FIG. 4, the geo-prioritized networks datastore 408 includes network data structures that are organized by priority, where the determination of priority includes a consideration of device location. A prioritized list could be stored as data structures in the geo-prioritized networks datastore 408 initially, and the data structures transformed later in accordance with geo-location data, or the data structures could be generated with the relevant priority. In either case, when device location changes enough, the geo-priority will change, and

the data structures can be transformed (or new data structures generated) to have the updated geo-priority.

[0080] In the example of FIG. 4, the geo-analysis connection engine 410 uses the geo-prioritized network list stored in the geo-prioritized networks datastore 408 to instruct the radio 404 to connect to a highest priority network that is available. Alternatively, the geo-analysis connection engine 410 could form a connection using the prioritized list as received from a server and use the geo-prioritized network list for subsequent connection determinations. As was previously noted, it is also possible that the geo-location engine 406 could be at least partially located at a server, and the prioritized list could include device location when prioritizing the network list.

[0081] As device location changes, performance of network can also change. The geo-analysis connection engine 410 can determine whether performance has dropped below a performance threshold using the performance threshold datastore 412. When performance drops below the performance threshold, the geo-analysis connection engine 410 can connect to a second network. The second network can be the next network on the geo-prioritized network list. It may be noted that the geo-location engine 406 can update the geo-prioritized networks datastore 408 so that network priorities change while a device is connected to a first network. So when performance drops below the performance threshold, the geo-analysis connection engine 410 can use the updated geo-prioritized network list to find a highest priority network that is available and instruct the radio 404 to connect to it. So the second network may or may not be the next highest priority network in the geo-prioritized list that was used when a connection to the first network was established.

[0082] Advantageously, the performance threshold setting can avoid frequent hopping between networks. Even if a second network has a higher geo-priority than a first network for which a device has a current connection, it may not be desirable to switch because of the risk of switching back and forth as performance fluctuates for the first and second (or other) networks. Thus, the performance threshold can be indicative of a performance that is “good enough” even if predicted performance of a second network exceeds the performance of the first network.

[0083] The performance threshold can be dynamically adjusted. While it is desirable to avoid frequent hopping between networks, a change in location can result in significantly higher performance on a second network. Even if the performance on the first network is “good enough,” the predicted performance of the second network may be sufficiently superior that the desire to avoid frequent hopping is eclipsed by the potential improved performance of the second network. Thus, the performance threshold can be a function of current performance on a first network and a predicted performance of a second network in addition to or instead of a performance threshold network switching preference.

[0084] When the performance threshold takes into account the performance of a first network to which a device is connected and a performance of a second network, the performance parameters of the first network and the second network need not be the same. For example, performance of the second network could include an access grant reliability parameter and a predicted delay in access grant parameter, while no such parameters are used to characterize performance of the first network. Other parameters may or may not be considered for characterizing both networks (e.g., post-connection network performance parameters or economic performance parameters).

[0085] In the example of FIG. 4, the selective network monitoring engine 414 can monitor networks other than a first network to which a subscriber is connected. Monitoring can include passive scans, which entail listening for beacon frames (or equivalent transmissions) from a WAP. The information available from beacon frames can vary depending upon network-specific variables. Active scanning typically produces more network information, but consumes more resources (e.g., wireless bandwidth, battery power, etc.).

[0086] The selective network monitoring engine 414 can monitor networks that are on the geo-prioritized networks list. Not all networks are necessarily treated equally when determining which to monitor, which is why the selective network monitoring engine 414 is called “selective.” For example, a prioritized list could indicate a preference for monitoring certain networks (not necessarily based upon the priority of the network). The selective monitoring of certain networks can be in order to limit the number of networks scanned by each of a plurality of devices that are relatively close to one another, to check on a network that has been flagged as

a poor performer to see if performance has changed, to keep the device aware of relatively high priority networks in case performance of a current network dips below a performance threshold, to obtain additional information about a network, or the like.

[0087] The selective network monitoring engine 414 can work in coordination with the geo-analysis connection engine 410. For example, the selective monitoring can be of networks that are high on the geo-prioritized networks list in order to keep network priorities as up-to-date as possible. The selective network monitoring engine 414 can also ensure that a dynamic performance threshold is updated with the most current network data. Data from selective network monitoring can be used at the device or sent to a server and provided in the form of a prioritized list after processing at the server.

[0088] The ANCS reporting engine 416 generates reports from ANCS of the selective network monitoring engine 414. The ANCS reporting engine 416 provides the ANCS reports to the radio 404 for transmission through the radio interface 402 to a server. The server can ensure that future prioritized lists are relatively current and, assuming an indication is provided by the server rather than derived from rules at the device, that selective network scanning indicators enable the device to scan networks in coordination with other devices or at least without wastefully consuming resources by providing less useful data regarding networks compared to more useful data that the server could use to more effectively prepare prioritized network lists for subscribers.

[0089] Advantageously, the system 400 provides location data and ANCS reports to a server to enable the server to generate prioritized network lists using the location and ANCS reports for the device sending the ANCS report and other subscribers (regardless of whether the other subscribers also send ANCS reports). The CSP 210 of FIG. 2 could, for example, include such a server.

[0090] Advantageously, the system 400 can customize prioritized network lists using a device's current location. For example, the geo-location engine 406 can customize prioritized network lists for a large geographic area in accordance with a device's current location, a motion trace (e.g., predictor of future location), or knowledge regarding historical network connection preferences. Alternatively, the geo-location engine 406 can receive a prioritized network list for

a local geographic area dependent on a device's current location and/or historical network connection preferences. Alternatively, the geo-location engine 406 can choose between multiple local geographic area network maps in accordance with a device's current location and/or historical network connection preferences.

[0091] Advantageously, the system 400 enables selective monitoring of networks on a prioritized network list to identify networks for which it is most optimal for a device to connect in a given geographic area. A device can apply implemented rules to determine an optimal network using a prioritized network list. The device can also selectively scan other networks to update the prioritized network list in accordance with what is discovered. This can benefit both the device and other subscribers.

[0092] Advantageously, the system 400 can reduce the likelihood of frequent jumping from one network to another as the network priority list changes or the performance on a given network fluctuates over time. The geo-analysis connection engine 410 can ensure a device remains connected to a network until performance drops below a minimum performance threshold.

[0093] FIG. 5 depicts a diagram of an example of a system 500 for using a motion trace to prioritize networks on a network map. In the example of FIG. 5, the system 500 a location detection engine 502, a location datastore 504, a location trace generation engine 506, a location trace datastore 508, a location trace reporting engine 510, a radio 512, a radio interface 514, and a location trace application engine 516.

[0094] In the example of FIG. 5, the location detection engine 502 is capable of determining a current location of a device. Although in this paper the location of the device is treated as a known value, it should be understood that location detection is often an estimate of current location. For example, a GPS system is not always capable of pinpoint accuracy. As another example, three WAPs could detect three signals having three different signal strengths from the device and determine location based on the distance, e.g., RSSI seems to indicate, but this triangulation technique is typically fairly inaccurate. However, any applicable known or convenient location estimation technique, regardless of its accuracy, can be sufficient if it

sufficiently accurate to enable application of techniques described in association with location detection in this paper.

[0095] In the example of FIG. 5, the location detection engine 502 stores the detected location in the location datastore 504. The data structures of the location datastore 504 can be as simple as coordinates in two-dimensional or three-dimensional space. It may be noted that while networks have ranges that extend into three-dimensional space, it may be useful to simplify to two-dimensional space (typically as an overlay over the ground or a floor of a building). More important than whether a z-axis component (altitude) is recorded is a timestamp for a given location. Thus, a minimalist location data structure will include an x-axis component (e.g., longitude), a y-axis component (e.g., latitude), and a timestamp, and a useful variant can include a z-axis component (e.g., altitude). The units of the axis components need not be the same. For example, the x- and y-axis components could be GPS coordinates and the x-axis component could be in feet (or meters) or a more abstract value, such as floors of a building.

[0096] In the example of FIG. 5, the location trace generation engine 506 can use historical location data to determine changes in location over time. By comparing the location associated with a first timestamp to a location associated with a second timestamp, it is possible to determine velocity as well as distance.

[0097] Velocity can be recorded in a vector data structure in the location trace datastore 508. As is true for datastores described in this paper in general, the location datastore 504 and the location trace datastore 508 can be implemented as the same datastore. For example, locations estimated by the location detection engine 502 could be stored as nodes and vectors calculated by the location trace generation engine 506 could be stored as edges between temporally adjacent nodes, in a single datastore. Alternatively, edges could be calculated on the fly such that only the nodes, with timestamps, are stored in non-volatile memory.

[0098] The location trace reporting engine 510 can generate a report for a server. The contents of the report can vary somewhat based upon implementation, but a minimal report will include at least the current location of the device and a timestamp. The server may or may not be capable

of generating a location trace, which means in an alternative at least a portion of the location trace generation engine 506 can be located at a server.

[0099] The radio 512 can send the location trace report through the radio interface 514 to a server. In response to receiving the location trace report, the server can provide a network map. In an alternative, the server need not receive the location trace in order to provide the network map; so the network map is not provided in response to receiving the location trace. The network map can be generated using ANCS reports from the device or from other devices. The network map may or may not be customized at the server using the location trace of the device.

[00100] The network map is a multi-dimensional map of networks to which the device can connect. The dimensions can include two or three spatial dimensions, time, network continuity, station velocity, device-specific history, or other parameters. Advantageously, the network map can be combined with device-specific characteristics to enable intelligent and reliable switching to or from wireless networks represented in the network map.

[00101] In the example of FIG. 5, the location trace application engine 516 can use the network map and location traces to choose a network for connection from the network map. Specifically, the location trace application engine 516 can use the motion trace to predict movement into or out of network service areas, and select networks that are appropriate for the predicted movement. Further processing of location traces beyond a determination of velocity can be useful. For example, high velocity followed by a short period of rest can be indicative of travel in a car, followed by stopping at a stoplight. In such a case, it may be desirable to avoid offloading even while the subscriber is stationary. As another example, a connection history could be used to show that some locations are typically passed through fairly quickly (e.g., a subscriber might walk to work through certain areas, making certain networks unappealing targets for offloading due to the likelihood that the subscriber will continue through the network relatively soon).

[00102] In a specific implementation, the network map can include zones of reliable coverage, which may be contiguous or disjoint. Thus, the location trace application engine 516 can use a network map of reliable networks and the location (or location trace) of the device to remove

networks that the device is likely to move in and out of coverage faster than a reliability threshold. The reliability threshold datastore 518 can store a data structure can include subscriber or service provider preferences for how quickly after a pause or slow movement to offload to another network. If the location trace velocity exceeds the reliability threshold, the device will not offload to certain networks (e.g., shorter-range networks).

[00103] As was mentioned previously, the location trace application engine 516 can make use of other information, such as connection history for a subscriber, activity that is indicative of being in a car or on public transportation, etc. to use a constructive velocity in the determination. Thus, even if the actual velocity of a subscriber is zero (e.g., when the subscriber is at a stop sign), the constructive velocity can have a higher value representative of the predicted future velocity. Constructive velocity can also be “net velocity” found by adding vectors over a period of time such that movement back-and-forth (e.g., if a subscriber is pacing). That is absolute velocity, or speed, of a subscriber over a relatively short period of time may not be as significant as the net velocity for the purpose of comparison to the reliability threshold.

[00104] When the location trace is applied to the network map to find a highest priority network to which the device can connect, the radio 512 can be instructed to authenticate and associate with the chosen network. Thus, offloading from one network to another can be achieved using a location trace of the device and a multi-dimensional network map.

[00105] FIG. 6 depicts a diagram of an example of a system 600 for using knowledge of subscriber network connections to prioritize network lists for subscribers. In the example of FIG. 6, the system 600 includes subscribers 602-1 to 602-N (collectively, subscribers 602), wireless networks 604-1 to 604-N (collectively, wireless networks 604), a subscriber interface 606, a connection tracking engine 608, a subscriber connections datastore 610, and a prioritized network list provisioning engine 612.

[00106] In the example of FIG. 6, the subscribers 602 can include stations that are capable of connecting to wireless networks. Depending upon the context, a subscriber can refer to a device or a person using the device. It is occasionally expedient for illustrative purposes to refer to subscriber data, which can include data about the user of the device, and the existence of a

subscriber record is not necessarily indicative of the existence of a device. However, the techniques described in this paper are generally applicable to a subscriber who can connect to a wireless network. Thus, the subscriber will, at least as used in the description of operation, always include a device.

[00107] In the example of FIG. 6, the wireless networks 604 can include a variety of different types of networks. For example, the wireless network 604-1 could be a Wi-Fi network and the wireless network 604-2 could be a 3G (cellular) network.

[00108] In the example of FIG. 6, the subscriber interface 606 is assumed to be on a server. It should be noted that details regarding how the subscribers 602 connect to the subscriber interface 606 are omitted. For example, the connection between the subscribers 602 can be through intervening networks including the Internet and/or a PSTN. In order for the subscribers 602 to connect to one of the wireless networks 604, the subscribers 602 may also have to connect through a WAP or base station. In an alternative, the subscriber interface 606 could be on a peer device (e.g., a station in an IBSS).

[00109] In the example of FIG. 6, the connection tracking engine 608 can receive data from the subscribers 602. The data can include ANCS reports and authentication data, but for the purpose of this example, the data includes data sufficient to identify the wireless networks 604 to which the subscribers 602 are connected. For example, subscribers 602-1 and 602-2 may indicate that they are connected to the wireless network 604-1, a Wi-Fi network in this example. Some of the subscribers 602 may not be connected with any of the wireless networks 604 at a given point in time, but are nevertheless known to the server due to authentication attempts, wireless transmissions, a wired connection, or for other applicable reasons.

[00110] In the example of FIG. 6, the subscriber connections datastore 610 stores a data structure that includes data sufficient to identify the wireless networks 604 with which the subscribers 602 are connected. The connection tracking engine 608 can modify the relevant data structure when one of the subscribers 602 disconnects from or connects to one of the wireless networks 604. The data structure may or may not also include data associated with networks for

which the subscribers are within range, though this information could also be derived from knowledge of a subscriber's location and a network map.

[00111] In the example of FIG. 6, the prioritized network list provisioning engine 612 can use data from the subscriber connections datastore 610 to determine, for example, how many of the subscribers 602 are connected to a given network, such as the wireless network 604-1. When generating a prioritized network list the prioritized network list provisioning engine 612 can use this information to steer subscribers away from wireless networks that have a relatively large number of connections and/or toward wireless networks that have a relatively small number of connections. A technique of a similar type is often referred to as network load balancing.

[00112] For example, assume subscribers 602-1 to 602-2 are connected to the wireless network 604-1 (a Wi-Fi network in this example) and the subscriber 602-N can be offloaded to the wireless network 604-1 from the wireless network 604-2 (a cellular network in this example). The prioritized network list provisioning engine 612 can use the knowledge of the number of devices 602-1 to 602-2 to prioritize the wireless network 604-1 in a prioritized network list that is to be provided to the subscriber 602-N. For the purposes of this example, the subscriber 602-N is in the service area of each of the wireless networks 604; so the prioritized network list can potentially include any or all of the wireless networks 604. If the prioritized network list provisioning engine 612 determines that the number of devices connected to the wireless network 604-1 exceeds an optimal number of connections threshold, the wireless network 604-1 can have a reduced priority in the prioritized list that is provided to the subscriber 602-N (or the wireless network 604-1 could be omitted from the prioritized list). In this way, the server can effectively advise devices contemplating a connection to a first network based upon the number of devices connected to the first network.

[00113] In the example of FIG. 6, the connections threshold 614 includes a data structure indicative of the number of connections that are acceptable. The number of connections that are acceptable may or may not vary by network. For example, some networks may be capable of supporting a larger number of connections. Also, some networks might be more predictably impacted by subscriber connections (e.g., a network that services a relatively large number of subscribers can improve predictability for a server that only receives connection information for

the subscribers and not for other wireless devices on the network), making connection data more useful to the prioritized network list provisioning engine 612 when weighting the various factors used to determine priority for networks.

[00114] FIG. 7 depicts a diagram of an example of a system 700 for using performance history to customize a prioritized network list. In the example of FIG. 7, the system 700 includes a prioritized list datastore 702, a historical performance evaluation engine 704, a performance history engine 706, a network connection engine 708, a radio 710, a performance monitoring engine 712, and a reliability threshold datastore 714.

[00115] In the example of FIG. 7, the prioritized list datastore 702 includes a prioritized network data structures. For the purposes of this example, the prioritized list datastore 702 is treated as including data structures with data sufficient to identify networks having service areas in which a device having the system 700 at least partially implemented is located and the priority of the networks. Of course, an actual implementation of the prioritized list datastore 702 could include additional data. The prioritized list datastore 702 can be populated by a server that sends a prioritized network list (not shown), the prioritized list could be generated at the device, or the prioritized list could be obtained in some other manner.

[00116] In the example of FIG. 7, the historical performance evaluation engine 704 can customize the prioritized list in the prioritized list datastore 702. In this way, in addition to using a prioritized list that has been prioritized based on reliability, location, time of day, or other factors that are described elsewhere in this paper, the device is capable of fine-tuning the prioritized list using on-device data.

[00117] In the example of FIG. 7, the performance history datastore 706 includes a data structure that is instructive regarding past performance for a given network. To the extent a network data structure exists in both the prioritized list datastore 702 and the performance history datastore 706, the historical performance evaluation engine 704 can compare the priority of the network to an actual performance history. Other networks in the prioritized list datastore 702 and the performance history datastore 706 can be similarly compared. Depending upon the implementation, the prioritized list datastore 702 can be updated with a customized prioritized

list that adjusts networks in the prioritized list based upon past performance. It is not necessarily the case that a network having superior network performance will have the highest priority (e.g., superior economic performance could be more important), and depending on the implementation, the subscriber may be able to adjust performance preferences as it relates to changing prioritization of networks.

[00118] In the example of FIG. 7, the network connection engine 708 can use the (now) customized prioritized list to select a network. The rules used to make the selection can be as simple as choosing the highest priority network from the customized prioritized network list. However, the network connection engine 708 could also have, e.g., an offload priority threshold that must be met in order to offload to, e.g., a Wi-Fi network from a cellular network. In other words, a cellular network could be a default and other networks would have to have, e.g., a performance advantage sufficient to merit offloading, regardless of prioritization. The network connection engine 708 could also be configured to connect to the highest priority network of the prioritized network list (prior to customization) and only use the customized prioritized list after some performance monitoring.

[00119] In the example of FIG. 7, the radio 710 is instructed to connect to a network that is selected by the network connection engine. Over time, the radio 710 will receive at least some network data (e.g., from packets received over the wireless medium) that can be used to monitor performance on the selected network. The radio 710 can also be instructed to scan other networks, as is described elsewhere in this paper, and the data obtained can be used to monitor performance on the other networks.

[00120] In the example of FIG. 7, the performance monitoring engine 712 at least monitors performance on the selected network, and may or may not also monitor performance on other networks. The data obtained can be stored in the performance history datastore 706 and used by the historical performance evaluation engine 704 to customize the prioritized list. The historical performance evaluation engine 704 and the performance monitoring engine 712 can operate in parallel or in some other fashion.

[00121] In the example of FIG. 7, the reliability threshold datastore 714 includes a data structure indicative of when the performance monitoring engine 712 will trigger the network connection engine 708 to switch networks. When the performance monitoring engine 712 determines that a network is, for example, sufficiently reliable, the network connection engine 708 can offload from, e.g., a cellular network, to, e.g., a sufficiently reliable Wi-Fi network. What is meant by “sufficiently reliable” is that a reliability threshold is established based upon user preferences for reliability, network configurations, or other factors that, when met, are indicative of sufficient reliability for an offload target. The reliability threshold is described elsewhere in this paper.

[00122] Advantageously, the system 700 enables a device to perform a network performance evaluation before deciding to connect to a network. The system 700 can then offload from a first network to a sufficiently reliable second network. The device can then continue to evaluate performance and decide whether to switch to another network based on performance. FIG. 8 depicts a diagram of an example of a system 800 for selecting network connections based on network prioritization. In the example of FIG. 8, the system 800 includes a subscriber user interface (UI) 802, a preference selection engine 804, a performance preferences datastore 806, an incentivized network selection engine 808, a prioritized list 810, a network connection engine 812, and a radio 814.

[00123] The subscriber UI 802 enables a user to view information about networks, preferences, and incentives, and to input data for use by the device. As such, the UI is presumed to include a display device (with drivers, if applicable) and an input device (with drivers, if applicable). By way of example but not limitation, the subscriber UI 802 could include a touchscreen input/output (I/O) device, a liquid crystal display (LCD) and keypad, or some other applicable known or convenient combination or collection of I/O device(s).

[00124] The preference selection engine 804 displays options on the subscriber UI. The options can include, for example, rules that dictate when to switch to or from networks or network types. For example, the user could define reliability, congestion state, QoS, performance, or some other parameter value. The user can also define incentive states. These settings can be in association with a specific network (e.g., a subscriber may have a high preference for offloading to home or

office Wi-Fi networks, which can be explicitly identified) or in association with a network type (e.g., a subscriber may have differing preferences for offloading to an 802.11a network or an 802.11b/g/n network).

[00125] The performance preferences datastore 806 stores data structures indicative of the performance and/or incentive settings selected at the preference selection engine 804. In a specific implementation, a user can update preferences at any time by, for example, triggering the preference selection engine 804 with a menu selection. Performance preferences can also be dynamic settings that can change in accordance with operational changes. For example, preferences may be different when a device has a full battery relative to when the device is running out of power. Thus, the preferences can be used in conjunction with or stored as rules for controlling operation of the device, specifically in this example, network connection selections by the device.

[00126] The incentivized network selection engine 808 uses a prioritized network list, which can be stored in the prioritized list datastore 810, and preferences and/or rules in the performance preferences datastore 806 to select a network and prompt the network connection engine 812 to control the radio 814 to connect to the selected network. In the example of FIG. 8, the subscriber can be provided with options that are displayed at the subscriber UI 802 and the subscriber can input data associated with those options. The amount of information provided to the subscriber can vary with implementation, but can include a list of all available networks, all available reliable networks, one or more aspects of network performance for displayed networks, or the like.

[00127] FIG. 9 depicts a conceptual display 900 associated with incentivized network selection. The display 900 includes a list of prioritized networks 902-1 to 902-N (collectively, prioritized network list 902), radio buttons 904, and state indicators 906. The prioritized network list 902 may or may not include all available networks, depending upon implementation- or configuration-specific parameters. For example, the subscriber may or may not be able to limit the list only to networks that meet certain performance or incentive specifications, or a service provider may or may not have a similar ability to prune the list of available networks. In the example of FIG. 9, the prioritized network list 902 is presumed to be ordered by priority, but a

priority indicator other than order could be used instead (e.g., priority could be indicated by a number in a column, text or background color, etc.).

[00128] In the example of FIG. 9, the radio buttons 904 are intended to illustrate a network selection mechanism. An applicable known or convenient mechanism for selecting one of the networks of the prioritized network list 902 could be used instead (e.g., the text of the prioritized network list 902 could be selectable such that if a user “clicked” on a network, that network would be selected). It should be noted that in a specific implementation the choice of network can be made by the device based upon a set of rules decided upon by a subscriber regarding when to connect to a network or switch to a new network.

[00129] In the example of FIG. 9, the state indicators 906 are intended to illustrate information that could be provided in association with a prioritized network list display. In the example of FIG. 9, the state indicators 906 include a column of performances 908-1 to 908-N (collectively, performance states 908), a column of availabilities 910-1 to 910-N (collectively, network availability states 910), and a column of incentives 912-1 to 912-N (collectively, incentive states 912). The state indicators 906 need not be displayed in a columnar or tabular form (e.g., data could be displayed by hovering over a network in the prioritized network list 902). The data can also be represented by color-coding (e.g., networks in the prioritized network list 902 could be displayed with red text if a corresponding congestion state of the network is high and green text if a corresponding congestion state of the network is low), or using some other applicable known or convenient technique to convey information about the state of a network.

[00130] As was mentioned elsewhere in this paper, performance can have many different meanings (e.g., network performance, economic performance, access grant performance, etc.). Thus, although there is one column of performance states 908, there could be several columns to indicate state or estimates for different types of performance. Within each type of performance, there may be additional subcategorizations (e.g., network performance can be measured in more than one way, including throughput, QoS, congestion, etc.) Performance can be summarized for a subscriber and presented as a single value (e.g., a number that is indicative of the relative performance of the network) or more explicit data can be provided (e.g., the basic radio bit rate of the network).

[00131] The network availability states 910 are related to performance, but are represented in a separate column due to some distinctions. Performance can be indicative of what can be expected if a connection is established with the corresponding network. Availability can be indicative of the likelihood with which a connection can be established. Reliability (not shown) can also be distinguished because it is indicative of the likelihood that performance will be consistent or a connection can be maintained over time (e.g., in consideration of a motion trace or zone of reliability based on time of day), which is somewhat different from both performance and availability. Reliability can be obviated as an indicator in an implementation in which only reliable networks are in the prioritized network list 902.

[00132] The incentive states 912 can indicate to a subscriber an “incentive offer” that may entice the subscriber to choose one network over another, regardless of prioritization.

[00133] FIG. 10 depicts a diagram of an example of a system 1000 for offering incentives to a subscriber to connect to a network. In the example of FIG. 10, the system 1000 includes a radio interface 1002, a radio 1004, an incentivized network selection engine 1006, a subscriber UI 1008, and a network connection engine 1010.

[00134] The radio 1004 receives an incentive offer from or on behalf of a network through the radio interface 1002. The incentive offer can be provided in a number of different ways, such as in beacon frames, in frames identifiable as “incentive frames,” in the body or header of a message, etc. It will typically be more valuable to send incentives to devices that are in a service area of a network, but depending upon implementation, incentives could be sent based upon predicted movement, probably in the immediate future, based upon connection history or a motion trace. In an alternative, the incentive offer is not received over the radio interface 1002, and is instead generated at the system 1000 in the incentivized network selection engine 1006 (or in an incentive offer generation engine, not shown).

[00135] The incentivized network selection engine 1006 enables a user to select the incentivized network through the subscriber UI 1008. The selection could also be made based upon rules or preferences that were previously input by the subscriber or a service provider. The network selection option could be presented as a pop-up window prompting a user to select whether to

connect to the applicable network in exchange for the incentive offer. Alternatively, the incentive offer could trigger a display similar to the display depicted by way of example in FIG. 9. Regardless of the mechanism used to provide the choice to the subscriber, the network connection engine 1010 can connect to the network in accordance with the subscriber's choice.

[00136] Advantageously, a service provider can identify one or more networks (e.g., Wi-Fi networks) that the service provider would like a subscriber to offload to. In the case of a cellular provider, this can enable the service provider to reduce load on the cellular network. By incentivizing the offloading, the service provider can expect a larger number of subscribers to offload than if no incentive was offered. The incentive offer can explain advantages of switching networks to the subscriber, which can include, for example, traffic charges are free or less expensive, one or more service capabilities or activities are available on, e.g., Wi-Fi that are not available or have a lower performance on, e.g., cellular, the subscriber gets a discount or credit for switching, etc.

[00137] FIG. 11 depicts a diagram of an example of a system 1100 for repeatedly cycling through performance tests. In the example of FIG. 11, the system 1100 includes a radio interface 1102, a radio 1104, a prioritized network selection engine 1106, a network connection engine 1108, a selective network monitoring engine 1110, and an ANCS reporting engine 1112.

[00138] The radio 1104 receives a prioritized list from a server through the radio interface 1102. The prioritized list could alternatively be generated at least in part at a device one which the system 1100 is implemented.

[00139] The prioritized network selection engine 1106 selects a priority network in accordance with any techniques described previously in this paper. The network connection engine 1108 controls the radio 1104 to connect to the applicable network. The network connection engine 1108 can perform a scan to determine available networks before or after obtaining the prioritized list.

[00140] The selective network monitoring engine 1110 can cycle through one or more network performance tests for a subset of the available networks. The ANCS reporting engine 1112 can report the results of the tests to a server through the radio 1104 and radio interface 1102. The

server could then perform a selection algorithm to select the network that best meets a network selection cost function and prioritize the network accordingly and provide another prioritized list. Alternatively, the device implementing the system 1100 can use the ANCS to customize the prioritized list. If the prioritized network selection engine 1106 selects a new network, the network connection engine 1108 can control the radio 1104 to connect to the selected network.

[00141] The selective network monitoring engine 1110 can repeatedly generate ANCS such that the prioritized list is continuously updated. In an alternative, the ANCS reports can be uploaded to a service controller function.

[00142] The embodiments illustrated in FIGS. 1-11 include components that can be selectively combined with one another. The cost functions of the various embodiments can include such parameters as signal strength, channel strength, basic radio bit rate, network speed, network throughput, speed jitter, throughput jitter, network delay, delay jitter, network availability, network reliability in successful network access grant percentage, delay in access grant, variation in performance as a function of performance, to name several.

[00143] FIG. 12 depicts a diagram of an example of a system 1200 capable of wireless network offloading and of enabling carriers to establish the wireless network offloading service. In the example of FIG. 12, the system 1200 includes a network 1202, a server 1204, an intelligent wireless offloading client 1206, and a service design center (SDC) 1208. The network 1202 will include a wireless network to which the intelligent wireless offloading client 1206 is connected, but can otherwise include any applicable known or convenient network suitable for linking the components of the system 1200. The server 1204 can be a server of a CSP or other service provider. The intelligent wireless offloading client 1206 can include capabilities of a wireless device and can include an implementation of any subset of the techniques described in this paper.

[00144] In one embodiment, the SDC 1208 acts as the portal to enable the service providers to set service plan parameters for the wireless networking offloading functionality. The SDC 1208 can enable the service providers to set charging rates for each of the different wireless network connections, such as a charging rate for Wi-Fi networks, a charging rate for 3G networks, a charging rate for 4G networks, etc. Each service provider may set different charging rates for the

same or different network connections. Each service provider may establish different service plans, each having different charging rates for the different wireless connections. For example, a service provider may have a service plan that benefits the highly mobile user, charging less for cell connections. A service provider may have a service plan that benefits those who anticipate reduced usage of cell connections.

[00145] In one embodiment, the SDC 1208 acts as the portal to enable the service providers to set notification parameters. For example, each service provider can set different notifications to motivate users to switch between wireless connections. These notifications and incentives can be temporal, geo-specific, service plan specific, etc.

[00146] In one embodiment, the SDC 1208 acts as the portal to enable the service providers to set access parameters. For example, each service provider can enable the various devices to access only a subset of available network connections, to offload to only certain network connections, etc.

[00147] The SDC 1208 further can provide functionality that may not be provided by the server 1204 or the intelligent wireless offloading client 1206. For example, the SDC 1208 can load algorithms for use at the client or server, set periodicity of scans by the client, set matrices, establish geographic boundaries of networks, set periodicity of reporting, etc.

[00148] Examples of the SDC 1208 can be found in the following related published applications, which are hereby incorporated by reference: U.S. publication No. 2010/0188975, filed March 2, 2009, entitled “Verifiable Device Assisted Service Policy Implementation,” U.S. publication No. 2010/0192170, filed March 2, 2009, entitled “Device Assisted Service Profile Management with User Preference, Adaptive Policy, Network Neutrality, and User Privacy,” U.S. publication No. 2010/0191612, filed March 2, 2009, entitled “Verifiable Device Assisted Service Usage Monitoring with Reporting, Synchronization, and Notification,” U.S. publication No. 2010/0191576, filed March 2, 2009, entitled “Verifiable Device Assisted Service Usage Billing with Integrated Accounting, Mediation Accounting, and Multi-Account,” U.S. publication No. 2010/0188991, filed March 2, 2009, entitled “Network Based Service Policy Implementation with Network Neutrality and User Privacy,” U.S. publication No.

2010/0188990, filed March 2, 2009, entitled "Network Based Service Profile Management with User Preference, Adaptive Policy, Network Neutrality and User Privacy," U.S. publication No. 2010/0192212, filed March 2, 2009, entitled "Automated Device Provisioning and Activation," U.S. publication No. 2010/0191604, filed March 2, 2009, entitled "Device Assisted Ambient Services," U.S. publication No. 2010/0191575, filed March 2, 2009, entitled "Network Based Ambient Services," U.S. publication No. 2010/0188993, filed March 2, 2009, entitled "Network Tools for Analysis, Design, Testing, and Production of Services," U.S. publication No. 2010/0190470, filed March 2, 2009, entitled "Roaming Services Network and Overlay Networks," U.S. publication No. 2010/0192120, filed March 2, 2009, entitled "Open Development System for Access Service Providers," U.S. publication No. 2010/0192207, filed March 2, 2009, entitled "Virtual Service Provider Systems," U.S. publication No. 2010/0191613, filed March 2, 2009, entitled "Open Transaction Central Billing System," U.S. publication No. 2010/0188995, filed March 2, 2009, entitled "Verifiable and Accurate Service Usage Monitoring for Intermediate Networking Devices," U.S. publication No. 2010/0188994, filed March 2, 2009, entitled "Verifiable Service Billing for Intermediate Networking Devices," U.S. publication No. 2010/0191846, filed March 2, 2009, entitled "Verifiable Service Policy Implementation for Intermediate Networking Devices," U.S. publication No. 2010/0188992, filed March 2, 2009, entitled "Service Profile Management with User Preference, Adaptive Policy, Network Neutrality and User Privacy for Intermediate Networking Devices," U.S. publication No. 2010/0191847, filed March 2, 2009, entitled "Simplified Service Network Architecture," U.S. publication No. 2010/0197266, filed January 27, 2010, entitled "Device Assisted CDR Creation, Aggregation, Mediation, and Billing," U.S. publication No. 2010/0198698, filed January 27, 2010, entitled "Adaptive Ambient Services," U.S. publication No. 2010/0199325, filed January 27, 2010, entitled "Security Techniques for Device Assisted Services," U.S. publication No. 2010/0197267, filed January 27, 2010, entitled "Device Group Partitions and Settlement Platform," U.S. publication No. 2010/0198939, filed January 27, 2010, entitled "Device Assisted Services Install," U.S. publication No. 2010/0195503, filed January 27, 2010, entitled "Quality of Service for Device Assisted Services," and U.S. publication No. 2010/0197268, filed January 28, 2010, entitled "Enhanced Roaming Services and Converged Carrier Networks with Device Assisted Services and a Proxy."

[00149] FIG. 13 depicts an example of a computer system 1300 on which techniques described in this paper can be implemented. The computer system 1300 may be a conventional computer system that can be used as a client computer system, such as a wireless client or a workstation, or a server computer system. The computer system 1300 includes a computer 1302, I/O devices 1304, and a display device 1306. The computer 1302 includes a processor 1308, a communications interface 1310, memory 1312, display controller 1314, non-volatile storage 1316, and I/O controller 1318. The computer 1302 may be coupled to or include the I/O devices 1304 and display device 1306.

[00150] The computer 1302 interfaces to external systems through the communications interface 1310, which may include a modem or network interface. It will be appreciated that the communications interface 1310 can be considered to be part of the computer system 1300 or a part of the computer 1302. The communications interface 1310 can be an analog modem, ISDN modem, cable modem, token ring interface, satellite transmission interface (e.g. "direct PC"), or other interfaces for coupling a computer system to other computer systems.

[00151] The processor 1308 may be, for example, a conventional microprocessor such as an Intel Pentium microprocessor or Motorola power PC microprocessor. The memory 1312 is coupled to the processor 1308 by a bus 1370. The memory 1312 can be Dynamic Random Access Memory (DRAM) and can also include Static RAM (SRAM). The bus 1370 couples the processor 1308 to the memory 1312, also to the non-volatile storage 1316, to the display controller 1314, and to the I/O controller 1318.

[00152] The I/O devices 1304 can include a keyboard, disk drives, printers, a scanner, and other input and output devices, including a mouse or other pointing device. The display controller 1314 may control in the conventional manner a display on the display device 1306, which can be, for example, a cathode ray tube (CRT) or liquid crystal display (LCD). The display controller 1314 and the I/O controller 1318 can be implemented with conventional well known technology.

[00153] The non-volatile storage 1316 is often a magnetic hard disk, an optical disk, or another form of storage for large amounts of data. Some of this data is often written, by a direct memory

access process, into memory 1312 during execution of software in the computer 1302. One of skill in the art will immediately recognize that the terms “machine-readable medium” or “computer-readable medium” includes any type of storage device that is accessible by the processor 1308 and also encompasses a carrier wave that encodes a data signal.

[00154] The computer system 1300 is one example of many possible computer systems which have different architectures. For example, personal computers based on an Intel microprocessor often have multiple buses, one of which can be an I/O bus for the peripherals and one that directly connects the processor 1308 and the memory 1312 (often referred to as a memory bus). The buses are connected together through bridge components that perform any necessary translation due to differing bus protocols.

[00155] Network computers are another type of computer system that can be used in conjunction with the teachings provided herein. Network computers do not usually include a hard disk or other mass storage, and the executable programs are loaded from a network connection into the memory 1312 for execution by the processor 1308. A Web TV system, which is known in the art, is also considered to be a computer system, but it may lack some of the features shown in FIG. 13, such as certain input or output devices. A typical computer system will usually include at least a processor, memory, and a bus coupling the memory to the processor.

[00156] In addition, the computer system 1300 is controlled by operating system software which includes a file management system, such as a disk operating system, which is part of the operating system software. One example of operating system software with its associated file management system software is the family of operating systems known as Windows® from Microsoft Corporation of Redmond, Washington, and their associated file management systems. Another example of operating system software with its associated file management system software is the Linux operating system and its associated file management system. The file management system is typically stored in the non-volatile storage 1316 and causes the processor 1308 to execute the various acts required by the operating system to input and output data and to store data in memory, including storing files on the non-volatile storage 1316.

[00157] Some portions of the detailed description are presented in terms of algorithms and symbolic representations of operations on data bits within a computer memory. These algorithmic descriptions and representations are the means used by those skilled in the data processing arts to most effectively convey the substance of their work to others skilled in the art. An algorithm is here, and generally, conceived to be a self-consistent sequence of operations leading to a desired result. The operations are those requiring physical manipulations of physical quantities. Usually, though not necessarily, these quantities take the form of electrical or magnetic signals capable of being stored, transferred, combined, compared, and otherwise manipulated. It has proven convenient at times, principally for reasons of common usage, to refer to these signals as bits, values, elements, symbols, characters, terms, numbers, or the like.

[00158] One skilled in the art should recognize that terms used are to be associated with the appropriate physical quantities and are merely convenient labels applied to these quantities. Unless specifically stated otherwise as apparent from the following discussion, it is appreciated that throughout the description, discussions utilizing terms such as “processing” or “computing” or “calculating” or “determining” or “displaying” or the like, refer to the action and processes of a computer system, or similar electronic computing device, that manipulates and transforms data represented as physical (electronic) quantities within the computer system's registers and memories into other data similarly represented as physical quantities within the computer system memories or registers or other such information storage, transmission or display devices.

[00159] The present invention, in some embodiments, also relates to apparatus for performing the operations herein. This apparatus may be specially constructed for the required purposes, or it may comprise a general purpose computer selectively activated or reconfigured by a computer program stored in the computer. Such a computer program may be stored in a computer readable storage medium, such as, but is not limited to, read-only memories (ROMs), random access memories (RAMs), EPROMs, EEPROMs, magnetic or optical cards, any type of disk including floppy disks, optical disks, CD-ROMs, and magnetic-optical disks, or any type of media suitable for storing electronic instructions, and each coupled to a computer system bus.

[00160] The algorithms and displays presented herein are not inherently related to any particular computer or other apparatus. Various general purpose systems may be used with programs in

accordance with the teachings herein, or it may prove convenient to construct more specialized apparatus to perform the required method steps. The required structure for a variety of these systems will appear from the description below. In addition, the present invention is not described with reference to any particular programming language, and various embodiments may thus be implemented using a variety of programming languages.

[00161] FIG. 14 depicts a flowchart 1400 of an example of a method for prioritized wireless offloading. The method is organized as a sequence of modules in the flowchart 1400. However, it should be understood that these and other modules associated with other methods described herein may be reordered for parallel execution or into different sequences of modules.

[00162] In the example of FIG. 14, the flowchart 1400 starts at module 1402 with obtaining wireless network data. The wireless network data can be obtained through ANCS at a wireless device. The ANCS can be used at the wireless device and/or can be provided to a server in an ANCS report. In an implementation that makes use of a server, the server can receive ANCS reports from multiple wireless devices. This can enable the server to generate prioritized lists for subscribers making use of network data that is remotely obtained relative to a subscriber.

[00163] In the example of FIG. 14, the flowchart 1400 continues to module 1404 with generating a prioritized network list from the wireless network data. In an implementation that makes use of a server, the server can perform an algorithm in memory to optimize capacity to a group of subscribers of a service provider associated with the server. The optimization can take into account network loading, wireless device location, wireless device connections, performance history (including, e.g., a time of day associated with a particular performance for a network), a network map over a geographic area, motion traces of wireless devices, subscriber preferences, incentives, and cost functions to name several. The prioritized list can take the form of a network map, which can be treated as a subset of prioritized list (with an added geo-location component).

[00164] In the example of FIG. 14, the flowchart 1400 continues to module 1406 with connecting to a network from the prioritized network list. A device may or may not customize a prioritized network list that is provided from a server in accordance with device-specific

parameters. Where customization does not occur, the server may take into account the device-specific parameters (as well as, e.g., account-specific parameters) when generating the prioritized list. Where customization does occur, in an implementation that includes a server, the prioritized list can still be partially customized at the server. Customization can be in accordance with monitored performance of networks within range of the device, subscriber-specified rules, service provider-specified rules, a location trace, performance history, environmental conditions, cost function, or incentives, to name several.

[00165] In the example of FIG. 14, the flowchart 1400 continues to module 1408 with monitoring network performance. The monitoring can be of the network to which the device is connected. The device can also monitor other networks, either passively or actively, in accordance with network monitoring rules. The rules can be provided by a service provider, SDC, or input directly.

[00166] In the example of FIG. 14, the flowchart 1400 returns to module 1402 and continues as described previously. It is not necessary that the same elements perform the same tasks described. For example, a server could initially generate a prioritized network list (1404), but on a second iteration, a wireless device could generate a (customized) prioritized network list without receiving a new prioritized list from the server. Also, there may be additional or fewer actions or determinations on a second iteration. For example, when a device first connects to a network (1406), it may be unnecessary to compare performance or some other parameter of a network with a threshold value to determine whether to switch to another network, but when the device considers switching from one network to another, it may be desirable to compare current performance with a threshold value to ensure it is “worth it” to switch to a (currently) more highly prioritized network.

[00167] FIG. 15 depicts a flowchart 1500 of an example of a method for using device assisted services (DAS) to facilitate wireless offloading. In the example of FIG. 15, the flowchart 1500 starts at module 1402 with monitoring network service usage activities of a device. The network service usage activities can be monitored with a verified/verifiable network performance characterization software (implemented in hardware) or hardware agent. The agent can be implemented on the device in question, on a different device, or can have components that are

implemented on more than one device. The monitoring can be accomplished using a radio and can be selective. An example of an agent that performs selective monitoring is the selective network monitoring engine 414 or the selective network monitoring engine 1110, respectively described by way of example with reference to FIGS. 4 and 11, or the performance monitoring engine 712 described by way of example with reference to FIG. 7.

[00168] In the example of FIG. 15, the flowchart 1500 continues to module 1504 with determining a network busy state based on the monitored network service usage activities. Network statistics can be stored in a network statistics datastore, such as the network statistics datastore 304 described by way of example with reference to FIG. 3. The network busy state can also be stored in a network statistics datastore or can be derived from statistics that are stored in the network statistics datastore. The network busy state can include a measure of network capacity, availability, and/or performance, and can be derived using techniques described in this paper. The network busy state can be determined with a network performance characterization software (implemented in hardware) or hardware agent, which can measure and/or characterize a network busy state experienced by a device. An example of an agent that performs network busy state determination is the network statistics characterization engine 306, such as is described by way of example with reference to FIG. 3 or the historical performance evaluation engine 704, such as is described by way of example with reference to FIG. 7.

[00169] In the example of FIG. 15, the flowchart 1500 continues to module 1506 with reporting the network busy state to a network element/function. The network busy state can be included in any of the reports described in this paper (e.g., a network busy state report, ANCS report, etc.). Depending on the implementation, the network busy state can be used by a network element/function on a wireless device, such as the wireless device that at least in part monitored network service usage activities and/or determined a network busy state, on a server, or on some other applicable device. An example of such a network element/function includes the wireless network offloading engine 106, such as is described by way of example with reference to FIG. 1.

[00170] In the example of FIG. 15, the flowchart 1500 continues to module 1508 with setting network access control policy for one or more network capacity controlled services using the network busy state. The network access control policy can be acted upon by the geo-analysis

connection engine 410, the network connection engine 708, the incentivized network selection engine 808 and/or the network connection engine 812, the incentivized network selection engine 1006 and/or the network connection engine 1010, the prioritized network selection engine 1106 and/or the network connection engine 1108, such as are respectively described by way of example with reference to FIGS. 4, 7, 8, 10, and 11.

[00171] Data on a wireless network is often encrypted. However, data may also be sent in the clear, if desired. With encrypted data, a rogue device will have a very difficult time learning any information (such as passwords, etc.) from clients before countermeasures are taken to deal with the rogue. The rogue may be able to confuse the client, and perhaps obtain some encrypted data, but the risk is minimal (even less than for some wired networks).

[00172] The following example illustrates possible benefits of this system. In one embodiment, a subscriber turns on a smart phone, the smart phone notices that the subscriber's home network is available. Assuming that the subscriber is connected to the cellular network and not connected to the home network, the cellular service provider sends the subscriber an incentive offer: a reduction in service fees if the subscriber offloads from the cellular network to his home network.

[00173] Upon traveling to work, the smart phone recognizes that the subscriber is no longer in the service area of his home network, but is within the service area of three of his neighbors' home networks and the cellular network. The smart phone recognizes that his motion trace (velocity) indicates movement that will move the subscriber out of the range of all three of his neighbors' home networks quickly. Thus, the smart phone may be configured to connect to the cellular network. Upon recognizing that the smart phone is stationary, e.g., at a stoplight, the smart phone may be configured to wait a predetermined period of time before considering to offload to a Wi-Fi network (especially if the smart phone knows the subscriber was moving). Accordingly, the smart phone may be configured to remain connected to the cellular network.

[00174] Upon reaching a destination, the smart phone recognizes that the motion trace becomes stationary or relatively slow and that the smart phone is proximate to two local Wi-Fi networks. In one embodiment, the beacon frames of the first Wi-Fi network may have higher received

signal strength indicators (RSSI). However, other subscribers may have provided network data about the first network that indicate the first network is typically severely congested at this time. Thus, the smart phone may be configured to indicate that the second network has a higher priority than the first network, despite the high RSSI.

[00175] In some embodiments, the smart phone receives a prioritized network list that indicates the second network as having a higher priority than the first network. In some embodiments, the smart phone is configured to connect to a wireless network in accordance with an incentive offer, to connect based on preferences set by the subscriber, or to wait for the subscriber to select a network from the prioritized network list.

[00176] To assist with information gathering, the smart phone may be configured to gather information about another local wireless network, e.g., about the first wireless network, and may report the information to the cellular service provider. While the smart phone is in range of the other local wireless network, the smart phone may passively or actively scan the other network. In some embodiments, the smart phone is configured to perform active scans only when the smart phone is plugged into a power source.

INCORPORATION BY REFERENCE

[00177] This application incorporates by reference the following U.S. Patent Applications for all purposes: U.S. serial No. 13/134,005, filed May 25, 2011, entitled “System and Method for Wireless Network Offloading”; U.S. serial No. 12/380,778 filed March 2, 2009, entitled “Verifiable Device Assisted Service Usage Billing with Integrated Accounting, Mediation Accounting, and Multi-Account”; U.S. serial No. 12/380,780 filed March 2, 2009, entitled “Automated Device Provisioning and Activation”; U.S. serial No. 12/695,019 filed January 27, 2010, entitled “Device Assisted CDR Creation, Aggregation, Mediation and Billing”; U.S. serial No. 12/695,020 filed January 27, 2010, entitled “Adaptive Ambient Services”; U.S. serial No. 12/694,445 filed January 27, 2010, entitled “Security Techniques for Device Assisted Services”; U.S. serial No. 12/694,451 filed January 27, 2010, entitled “Device Group Partitions and Settlement Platform”; U.S. serial No. 12/694,455 filed January 27, 2010, entitled “Device Assisted Services Install”; U.S. serial No. 12/695,021 filed January 27, 2010, entitled “Quality of

Service for Device Assisted Services”; and U.S. serial No. 12/695,980 filed January 28, 2010, entitled “Enhanced Roaming Services and Converged Carrier Networks with Device Assisted Services and a Proxy”.

[00178] This application also incorporates by reference the following U.S. provisional applications: U.S. provisional application serial No. 61/206,354, filed January 28, 2009, entitled “Services Policy Communication System and Method”; U.S. provisional application serial No. 61/206,944, filed February 4, 2009, entitled “Services Policy Communication System and Method”; U.S. provisional application serial No. 61/207,393, filed February 10, 2009, entitled “Services Policy Communication System and Method”; U.S. provisional application serial No. 61/207,739, filed February 13, 2009, entitled “Services Policy Communication System and Method”; U.S. provisional application serial No. 61/270,353, filed July 6, 2009, entitled “Device Assisted CDR Creation, Aggregation, Mediation and Billing”; U.S. provisional application serial No. 61/275,208, filed August 25, 2009, entitled “Adaptive Ambient Services”; U.S. provisional application serial No. 61/237,753, filed August 28, 2009, entitled “Adaptive Ambient Services”; U.S. provisional application serial No. 61/252,151, filed October 15, 2009, entitled “Security Techniques for Device Assisted Services”; U.S. provisional application serial No. 61/252,153, filed October 15, 2009, entitled “Device Group Partitions and Settlement Platform”; U.S. provisional application serial No. 61/264,120, filed November 24, 2009, entitled “Device Assisted Services Install,” and U.S. provisional application serial No. 61/264,126, filed November 24, 2009, entitled “Device Assisted Services Activity Map”; U.S. provisional application serial No. 61/348,022, filed May 25, 2010, entitled “Device Assisted Services for Protecting Network Capacity”; U.S. provisional application serial No. 61/381,159, filed September 9, 2010, entitled “Device Assisted Services for Protecting Network Capacity”; U.S. provisional application serial No. 61/381,162, filed September 9, 2010, entitled “Service Controller Interfaces and Workflows”; U.S. provisional application serial No. 61/384,456, filed September 20, 2010, entitled “Securing Service Processor with Sponsored SIMs”; U.S. provisional application serial No. 61/389,547, filed October 4, 2010, entitled “User Notifications for Device Assisted Services”; U.S. provisional application serial No. 61/385,020, filed September 21, 2010, entitled “Service Usage Reconciliation System Overview”; U.S. provisional application serial No. 61/387,243, filed September 28, 2010, entitled “Enterprise and Consumer

Billing Allocation for Wireless Communication Device Service Usage Activities”; U.S. provisional application serial No. 61/387,247, filed September 28, 2010, entitled “Secured Device Data Records”; U.S. provisional application serial No. 61/407,358, filed October 27, 2010, entitled “Service Controller and Service Processor Architecture”; U.S. provisional application serial No. 61/418,507, filed December 1, 2010, entitled “Application Service Provider Interface System”; U.S. provisional application serial No. 61/418,509, filed December 1, 2010, entitled “Service Usage Reporting Reconciliation and Fraud Detection for Device Assisted Services”; U.S. provisional application serial No. 61/420,727, filed December 7, 2010, entitled “Secure Device Data Records”; U.S. provisional application serial No. 61/422,565, filed December 13, 2010, entitled “Service Design Center for Device Assisted Services”; U.S. provisional application serial No. 61/422,572, filed December 13, 2010, entitled “System Interfaces and Workflows for Device Assisted Services”; U.S. provisional application serial No. 61/422,574, filed December 13, 2010, entitled “Security and Fraud Detection for Device Assisted Services”; U.S. provisional application serial No. 61/435,564, filed January 24, 2011, entitled “Framework for Device Assisted Services”; and U.S. provisional application serial No. 61/472,606, filed April 6, 2011, entitled “Managing Service User Discovery and Service Launch Object Placement on a Device.”

Electronic Acknowledgement Receipt	
EFS ID:	27698176
Application Number:	15369542
International Application Number:	
Confirmation Number:	6887
Title of Invention:	System and Method for Wireless Network Offloading
First Named Inventor/Applicant Name:	Gregory G. Raleigh
Customer Number:	106963
Filer:	James E. Harris/Ann Taylor
Filer Authorized By:	James E. Harris
Attorney Docket Number:	RALEP049D1C1
Receipt Date:	05-DEC-2016
Filing Date:	
Time Stamp:	18:08:28
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	P049D1C1_ADS.pdf	1824022	no	12
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Warnings:

Information:					
2	Drawings-only black and white line drawings	P049D1C1_Drawings.pdf	307524	no	15
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Warnings:					
Information:					
3	Oath or Declaration filed	P049D1C1_LavineDecl.pdf	64000	no	1
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Warnings:					
Information:					
4	Oath or Declaration filed	P049D1C1_RaissiniaDecl.pdf	65781	no	1
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Warnings:					
Information:					
5	Oath or Declaration filed	P049D1C1_RaleighDecl.pdf	64535	no	1
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Warnings:					
Information:					
6	Power of Attorney	HWPI_POA2016.pdf	387200	no	2
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Warnings:					
Information:					
7		P049D1C1_Application.pdf	309446	yes	53
			256db3d27cbc16ed5489c3115c2861569743f56a		
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Abstract		53	53	
	Claims		52	52	
	Specification		1	51	

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	RALEP049D1C1
		Application Number	
Title of Invention	System and Method for Wireless Network Offloading		
<p>The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76. This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.</p>			

Secrecy Order 37 CFR 5.2:

☐	Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)
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Inventor Information:

Inventor	1				Remove	
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Application Data Sheet 37 CFR 1.76		Attorney Docket Number		RALEP049D1C1	
		Application Number			
Title of Invention	System and Method for Wireless Network Offloading				
City	Corte Madera	State/Province	CA	Country of Residence	US
Mailing Address of Inventor:					
Address 1	1011 Pruitt Place				
Address 2					
City	Tyler	State/Province	TX		
Postal Code	75703	Country	US		
All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button.					<input type="button" value="Add"/>

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).			
☐ An Address is being provided for the correspondence information of this application.			
Customer Number	106963		
Email Address	patent@headwaterllc.com	<input type="button" value="Add Email"/>	<input type="button" value="Remove Email"/>

Application Information:

Title of the Invention	System and Method for Wireless Network Offloading		
Attorney Docket Number	RALEP049D1C1	Small Entity Status Claimed	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	15	Suggested Figure for Publication (if any)	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)
☐ Request Not to Publish. I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application has not and will not be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	RALEP049D1C1
		Application Number	
Title of Invention	System and Method for Wireless Network Offloading		

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:			
☒ Customer Number	☐ US Patent Practitioner	☐ Limited Recognition (37 CFR 11.9)	
Customer Number	106963		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending		Remove		
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
thisapplication	Continuation of	14156428	2014-01-15		
Prior Application Status	Patented		Remove		
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
14156428	Division of	13134005	2011-05-25	8635335	2014-01-21
Prior Application Status	Patented		Remove		
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
13134005	Continuation in part of	12380778	2009-03-02	8321526	2012-11-27
Prior Application Status	Patented		Remove		
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
13134005	Continuation in part of	12380780	2009-03-02	8839388	2014-09-16
Prior Application Status	Expired		Remove		
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
13134005	Claims benefit of provisional	61348022	2010-05-25		

Application Data Sheet 37 CFR 1.76		Attorney Docket Number RALEP049D1C1	
		Application Number	
Title of Invention	System and Method for Wireless Network Offloading		

Prior Application Status	Expired	Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13134005	Claims benefit of provisional	61381159	2010-09-09
Prior Application Status	Expired	Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13134005	Claims benefit of provisional	61381162	2010-09-09
Prior Application Status	Expired	Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13134005	Claims benefit of provisional	61384456	2010-09-20
Prior Application Status	Expired	Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13134005	Claims benefit of provisional	61385020	2010-09-21
Prior Application Status	Expired	Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13134005	Claims benefit of provisional	61387243	2010-09-28
Prior Application Status	Expired	Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13134005	Claims benefit of provisional	61387247	2010-09-28
Prior Application Status	Expired	Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13134005	Claims benefit of provisional	61389547	2010-10-04
Prior Application Status	Expired	Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13134005	Claims benefit of provisional	61407358	2010-10-27
Prior Application Status	Expired	Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13134005	Claims benefit of provisional	61418507	2010-12-01

Application Data Sheet 37 CFR 1.76		Attorney Docket Number		RALEP049D1C1	
		Application Number			
Title of Invention	System and Method for Wireless Network Offloading				

Prior Application Status	Expired	Remove			
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
13134005	Claims benefit of provisional	61418509	2010-12-01		
Prior Application Status	Expired	Remove			
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
13134005	Claims benefit of provisional	61420727	2010-12-07		
Prior Application Status	Expired	Remove			
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
13134005	Claims benefit of provisional	61422565	2010-12-13		
Prior Application Status	Expired	Remove			
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
13134005	Claims benefit of provisional	61422572	2010-12-13		
Prior Application Status	Expired	Remove			
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
13134005	Claims benefit of provisional	61422574	2010-12-13		
Prior Application Status	Expired	Remove			
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
13134005	Claims benefit of provisional	61435564	2011-01-24		
Prior Application Status	Expired	Remove			
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
13134005	Claims benefit of provisional	61472606	2011-04-06		
Prior Application Status	Expired	Remove			
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
12380778	Claims benefit of provisional	61206354	2009-01-28		
Prior Application Status	Expired	Remove			
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
12380778	Claims benefit of provisional	61206944	2009-02-04		

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	RALEP049D1C1
		Application Number	
Title of Invention	System and Method for Wireless Network Offloading		

Prior Application Status	Expired	Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
12380778	Claims benefit of provisional	61207393	2009-02-10
Prior Application Status	Expired	Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
12380778	Claims benefit of provisional	61207739	2009-02-13
Prior Application Status	Expired	Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
12380780	Claims benefit of provisional	61206354	2009-01-28
Prior Application Status	Expired	Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
12380780	Claims benefit of provisional	61206944	2009-02-04
Prior Application Status	Expired	Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
12380780	Claims benefit of provisional	61207393	2009-02-10
Prior Application Status	Expired	Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
12380780	Claims benefit of provisional	61207739	2009-02-13
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the Add button.			Add

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)¹ the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	RALEP049D1C1								
		Application Number									
Title of Invention	System and Method for Wireless Network Offloading										
<table border="1"> <thead> <tr> <th>Application Number</th> <th>Countryⁱ</th> <th>Filing Date (YYYY-MM-DD)</th> <th>Access Code^j (if applicable)</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>				Application Number	Country ⁱ	Filing Date (YYYY-MM-DD)	Access Code ^j (if applicable)				
Application Number	Country ⁱ	Filing Date (YYYY-MM-DD)	Access Code ^j (if applicable)								
Additional Foreign Priority Data may be generated within this form by selecting the Add button.											

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013. NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	RALEP049D1C1
		Application Number	
Title of Invention	System and Method for Wireless Network Offloading		

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h) (1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	RALEP049D1C1
		Application Number	
Title of Invention	System and Method for Wireless Network Offloading		

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant	1	Remove
<p>If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.</p> <p style="text-align: right;">Clear</p>		
☐ Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor
Person to whom the inventor is obligated to assign.		Person who shows sufficient proprietary interest
If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:		
<div style="border: 1px solid black; height: 15px; width: 100%;"></div>		
Name of the Deceased or Legally Incapacitated Inventor: <div style="border: 1px solid black; height: 20px; width: 100%;"></div>		
If the Applicant is an Organization check here. ☒		
Organization Name	Headwater Partners I LLC	
Mailing Address Information For Applicant:		
Address 1	1011 Pruitt Place	
Address 2		
City	Tyler	State/Province TX
Country	US	Postal Code 75703
Phone Number	903-201-6212	Fax Number
Email Address	patent@headwaterllc.com	
Additional Applicant Data may be generated within this form by selecting the Add button. Add		

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	RALEP049D1C1
		Application Number	
Title of Invention	System and Method for Wireless Network Offloading		

Assignee 1				
Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.				
				<input type="button" value="Remove"/>
If the Assignee or Non-Applicant Assignee is an Organization check here. ☐				
Prefix	Given Name	Middle Name	Family Name	Suffix
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Mailing Address Information For Assignee including Non-Applicant Assignee:				
Address 1		<input type="text"/>		
Address 2		<input type="text"/>		
City	<input type="text"/>	State/Province	<input type="text"/>	
Country ⁱ	<input type="text"/>	Postal Code	<input type="text"/>	
Phone Number	<input type="text"/>	Fax Number	<input type="text"/>	
Email Address	<input type="text"/>			
Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.				<input type="button" value="Add"/>

Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). However, if this Application Data Sheet is submitted with the **INITIAL** filing of the application and either box A or B is **not** checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/James E. Harris/		Date (YYYY-MM-DD)	2016-12-02
First Name	James E.	Last Name	Harris	Registration Number
Additional Signature may be generated within this form by selecting the Add button.				<input type="button" value="Add"/>

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	RALEP049D1C1
		Application Number	
Title of Invention	System and Method for Wireless Network Offloading		

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

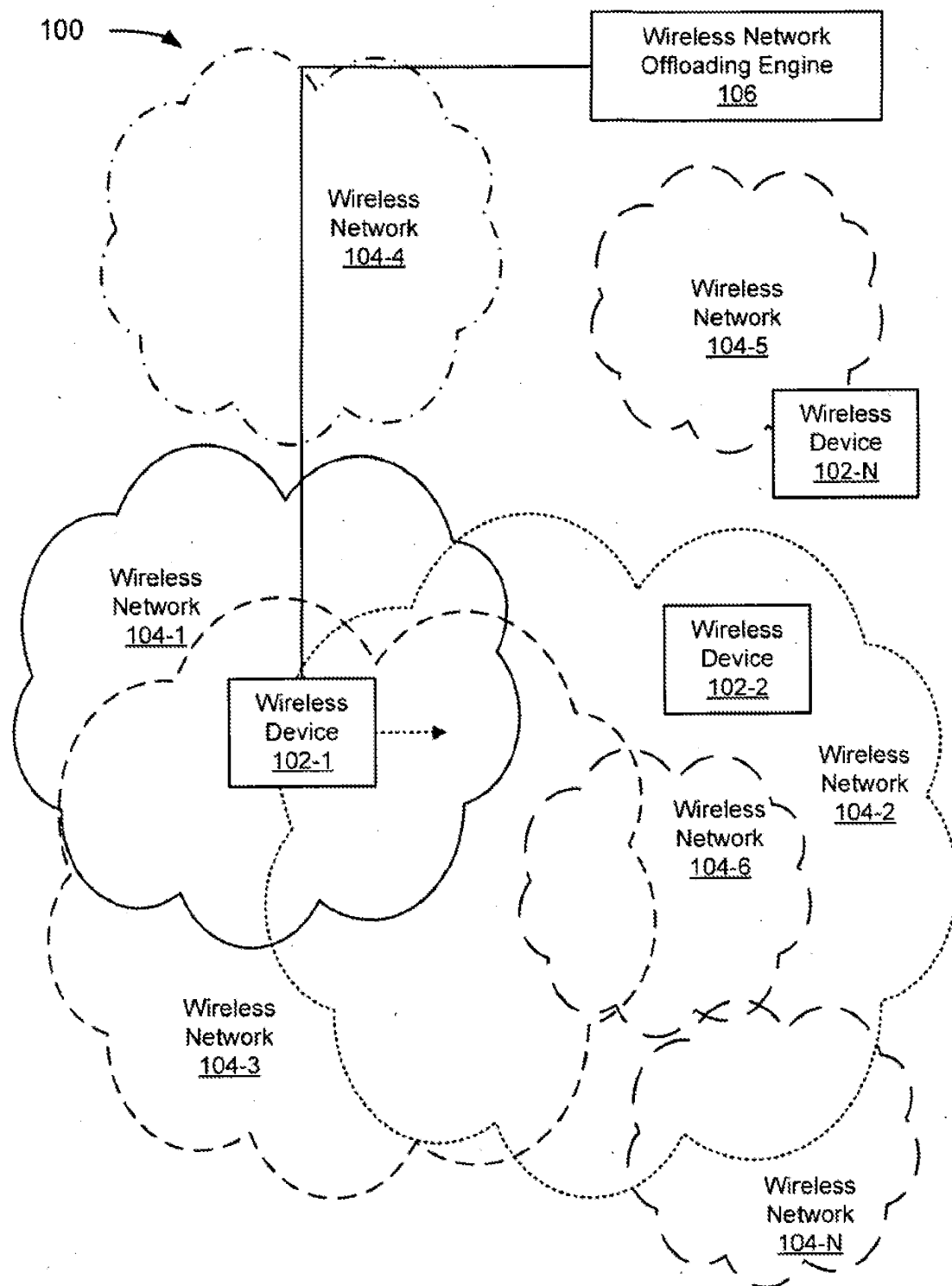


FIG. 1

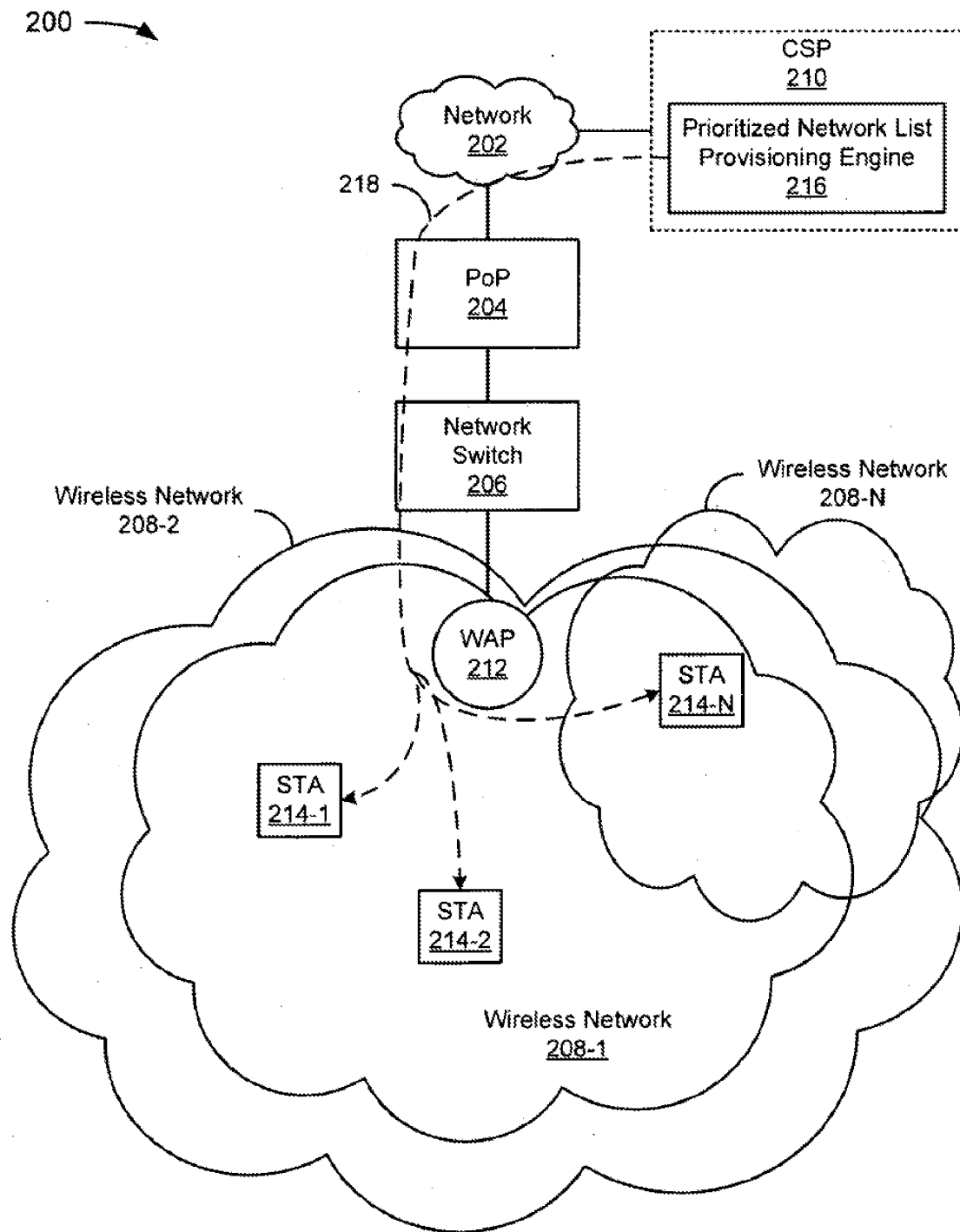


FIG. 2

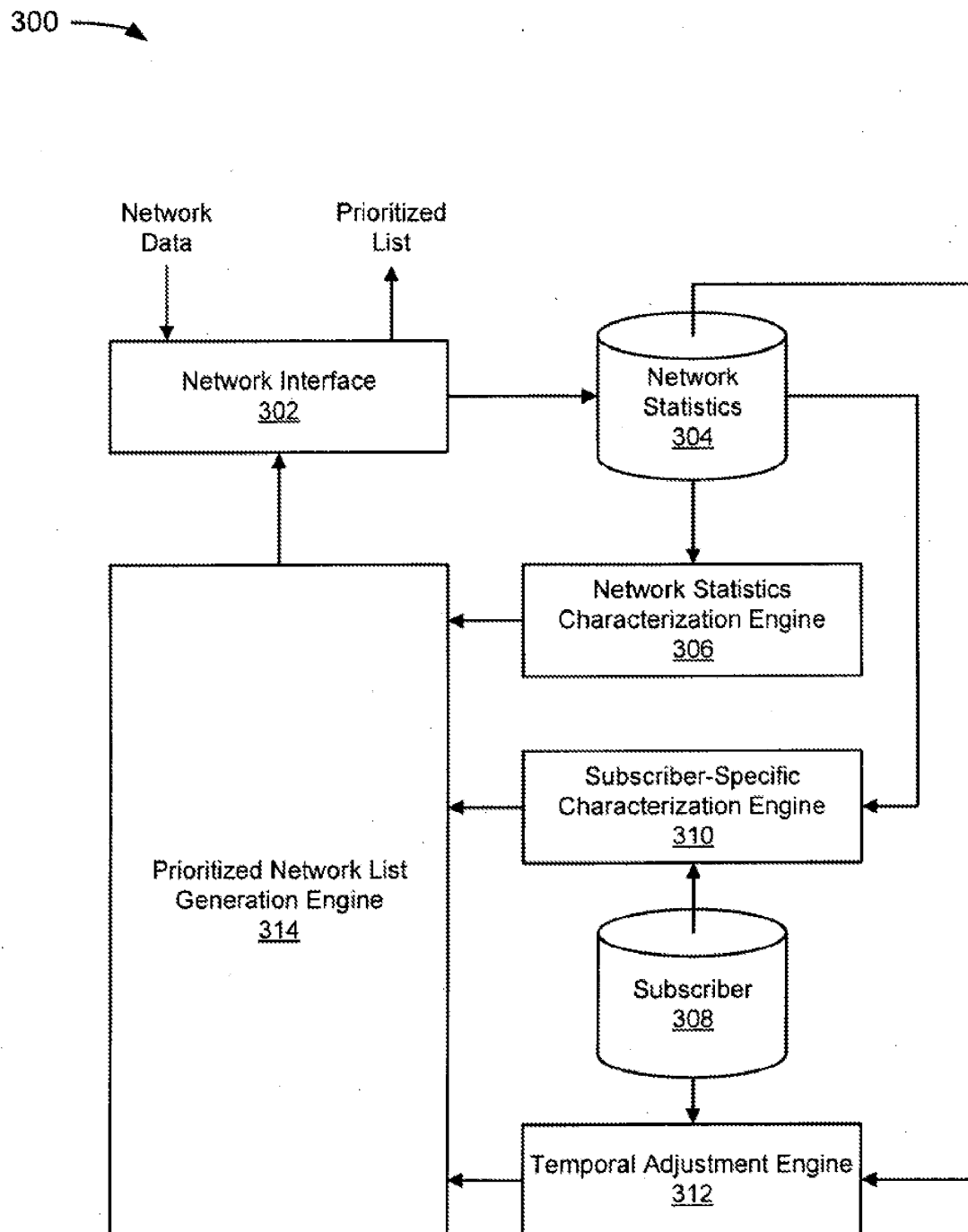


FIG. 3

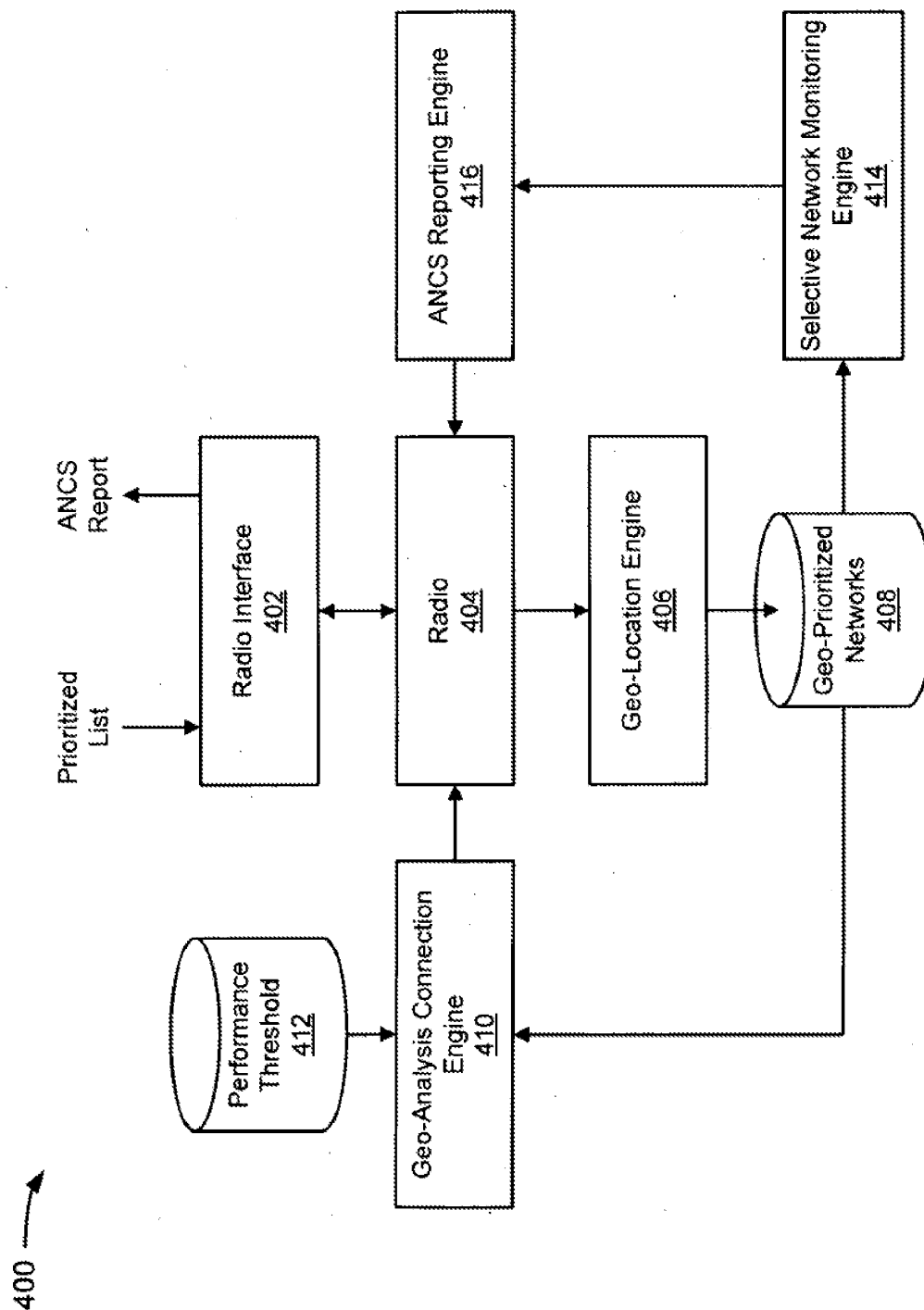


FIG. 4

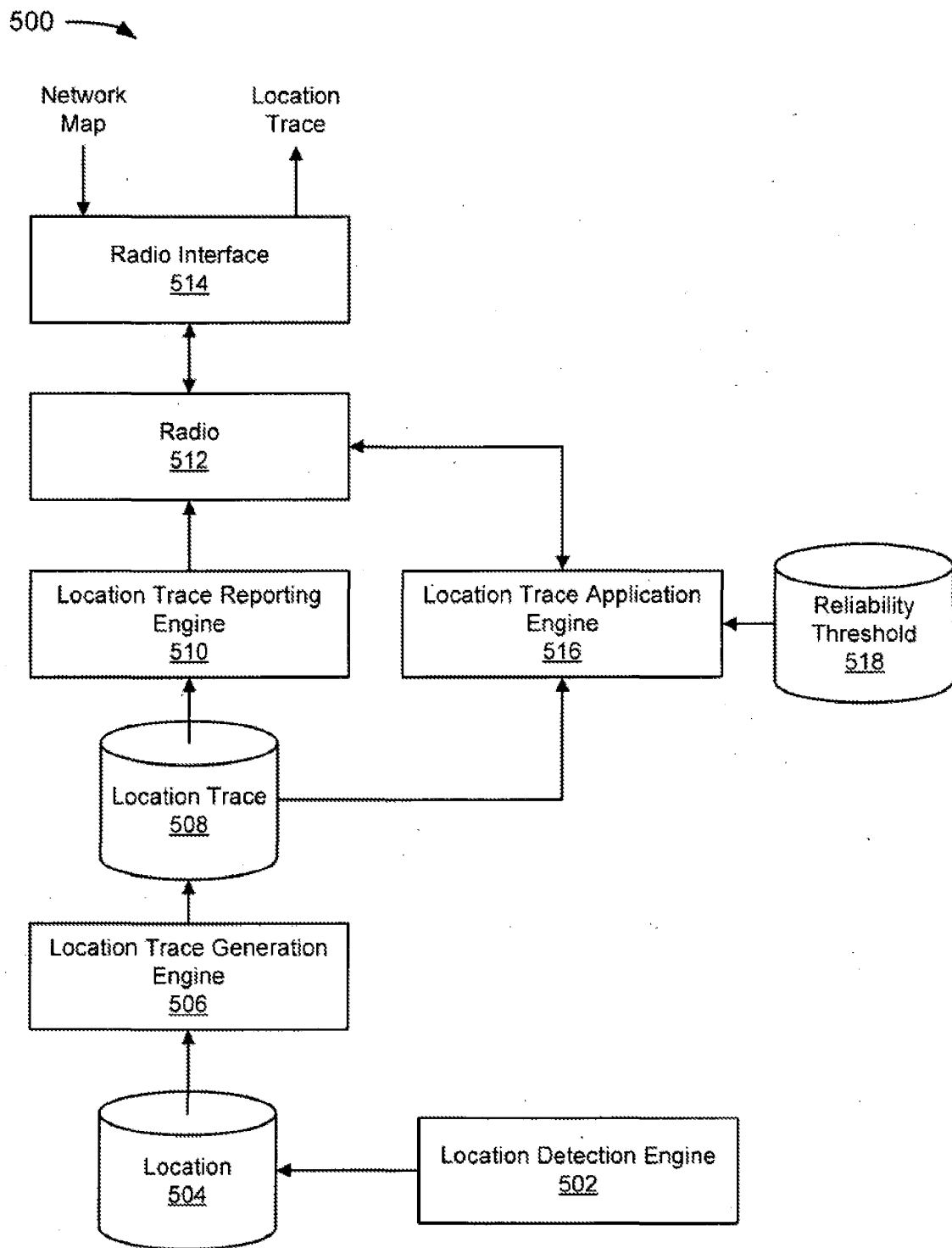


FIG. 5

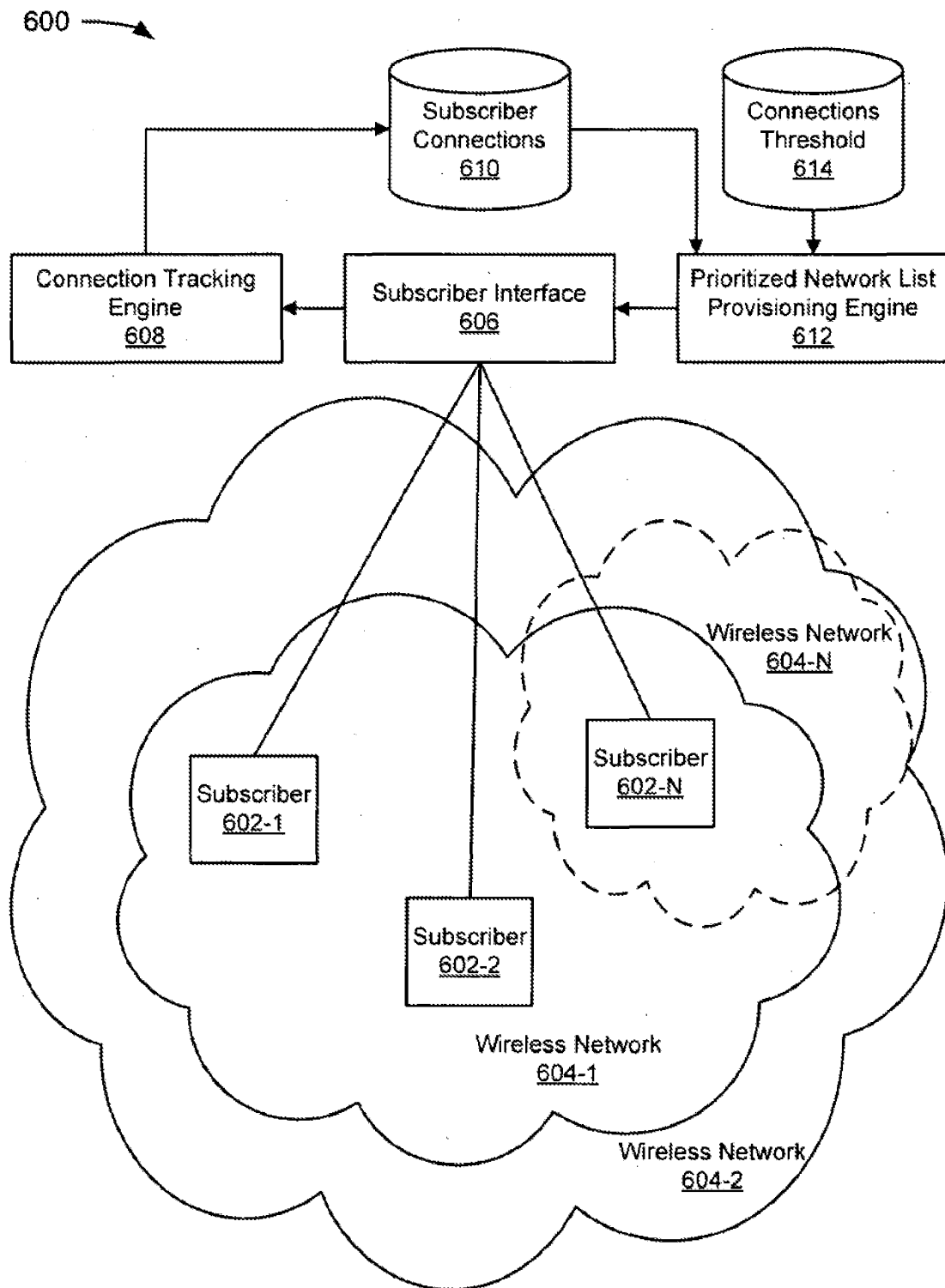
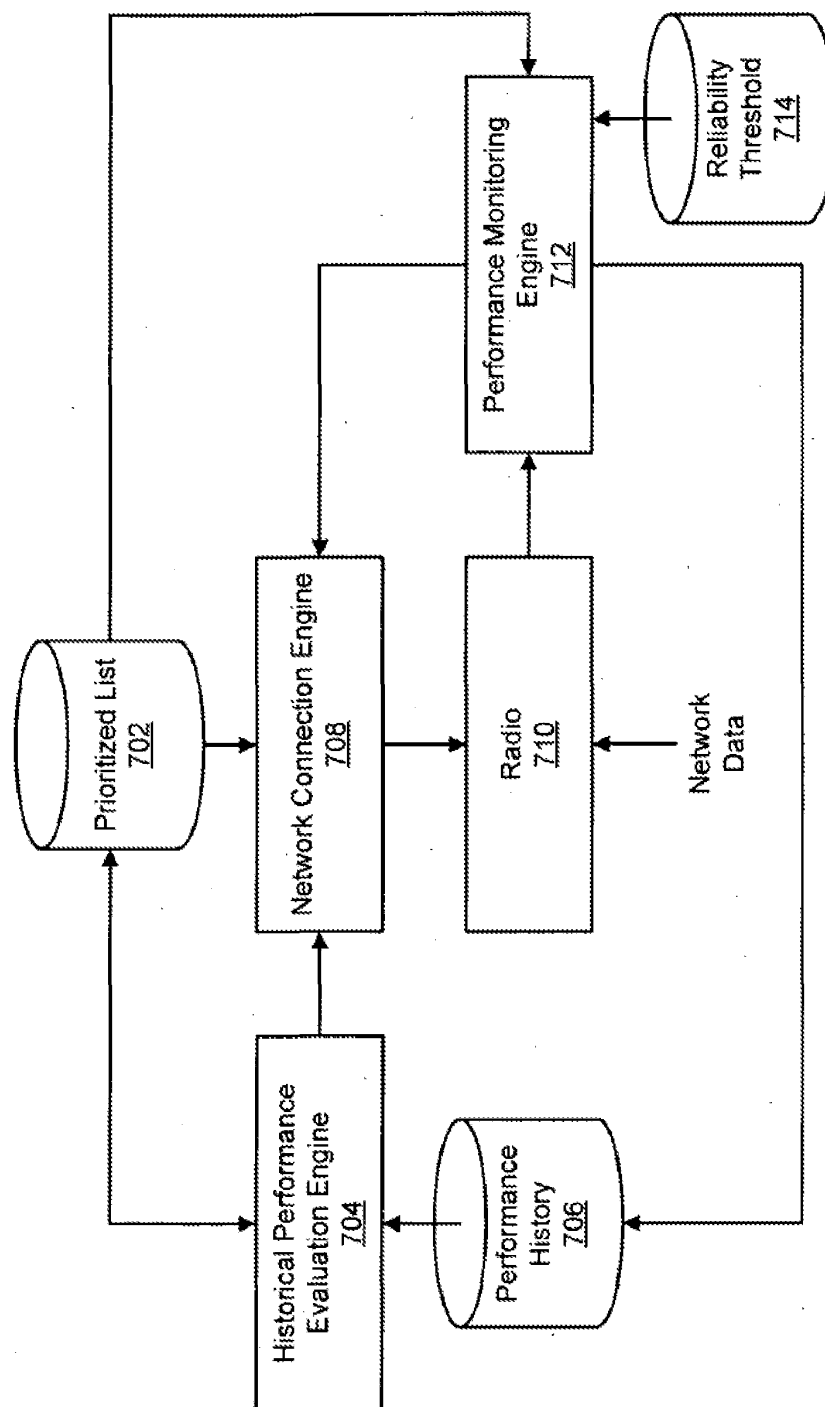


FIG. 6



800 →

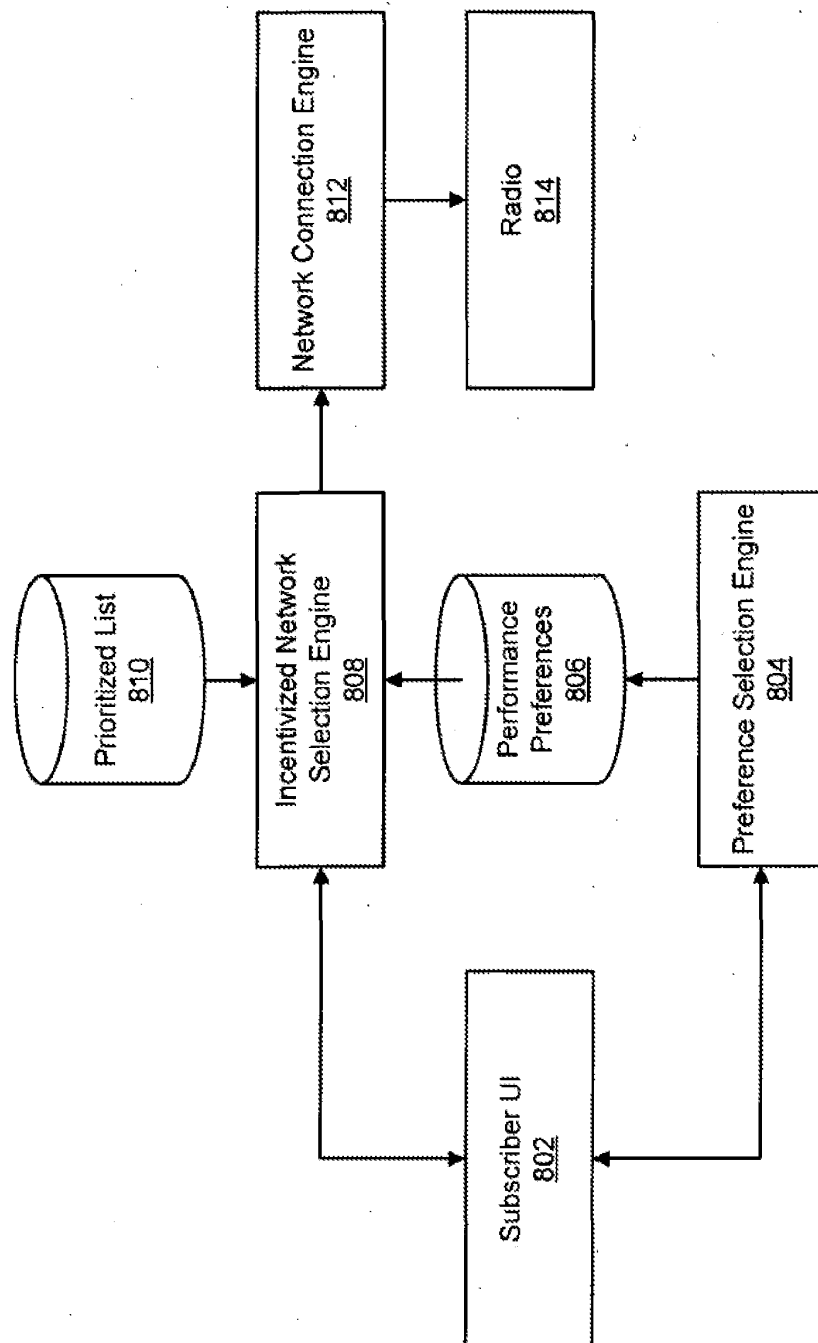


FIG. 8

900 →

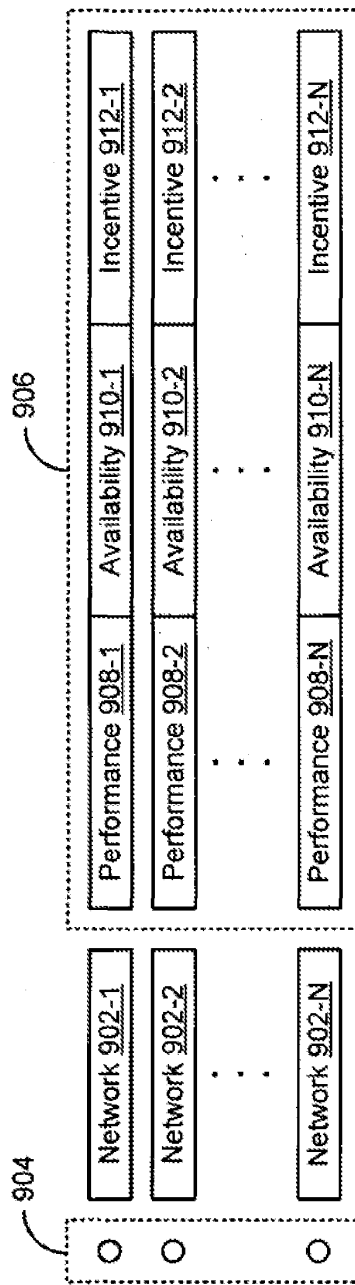


FIG. 9

1000 →

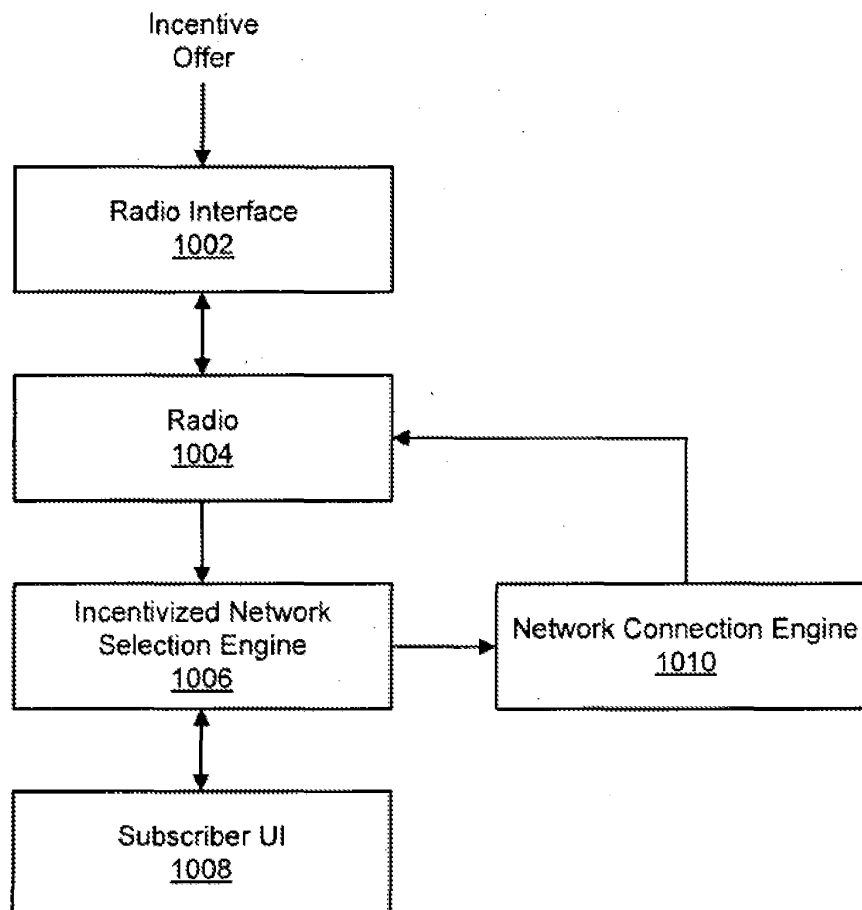


FIG. 10

1100 →

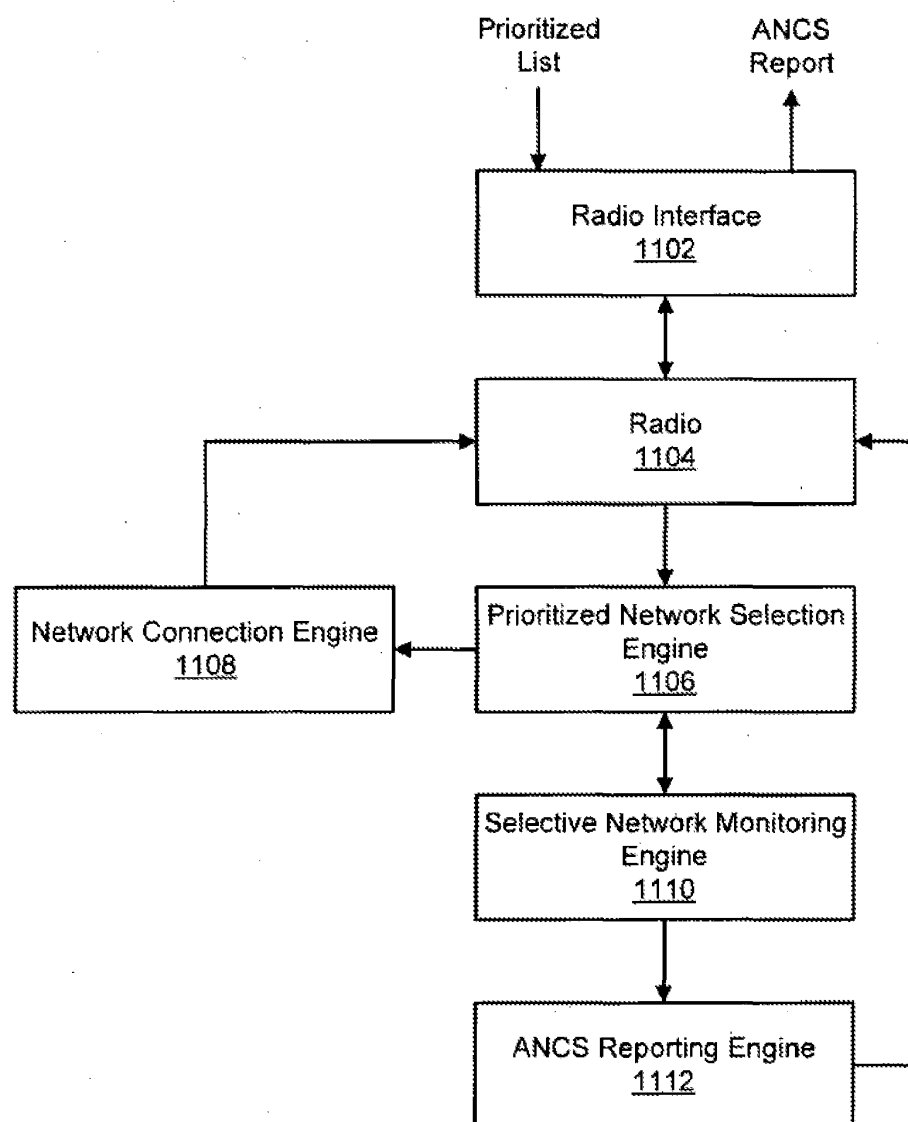


FIG. 11

1200 →

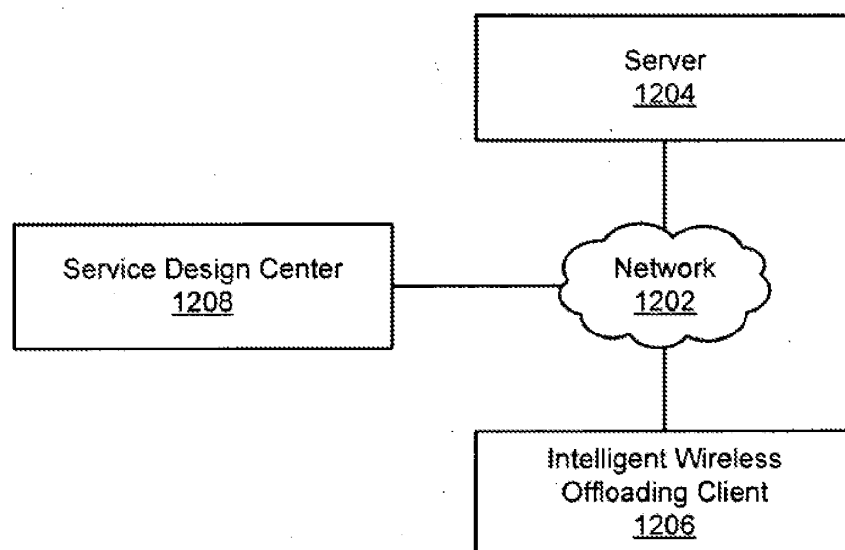


FIG. 12

1300 →

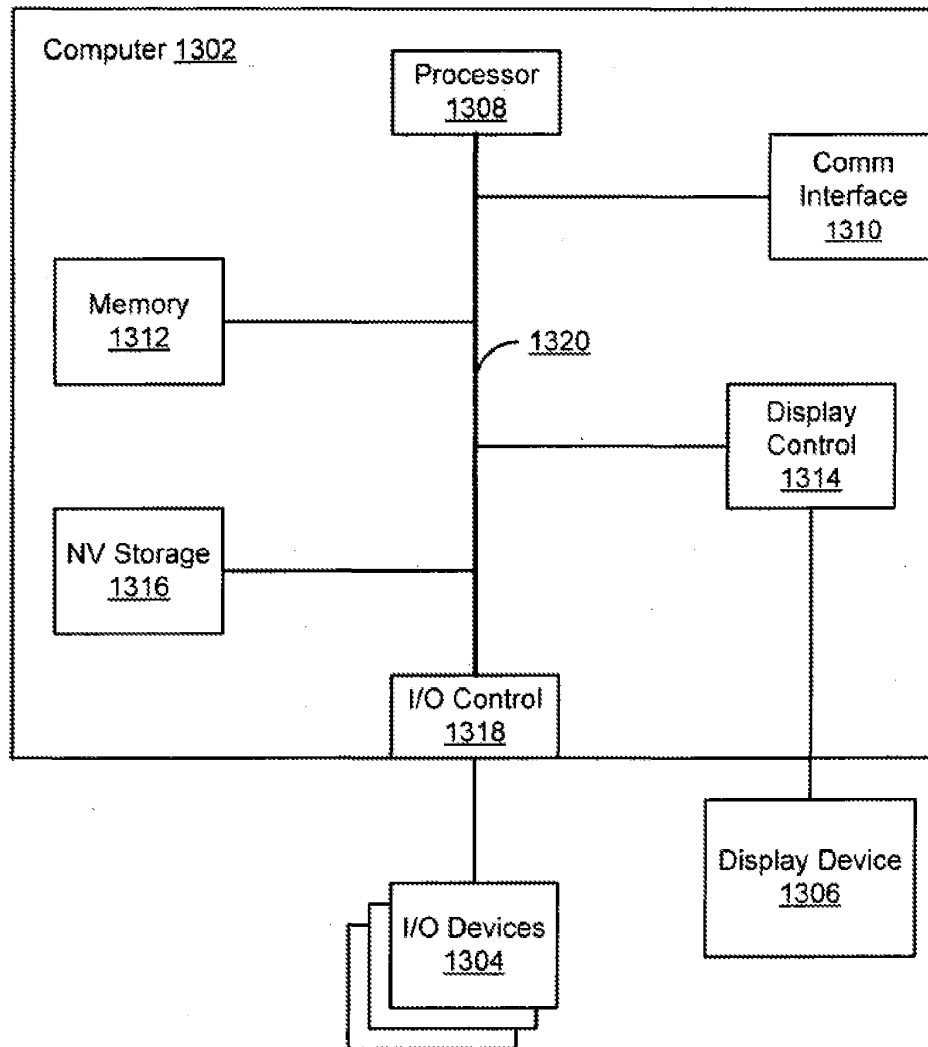


FIG. 13

1400 →

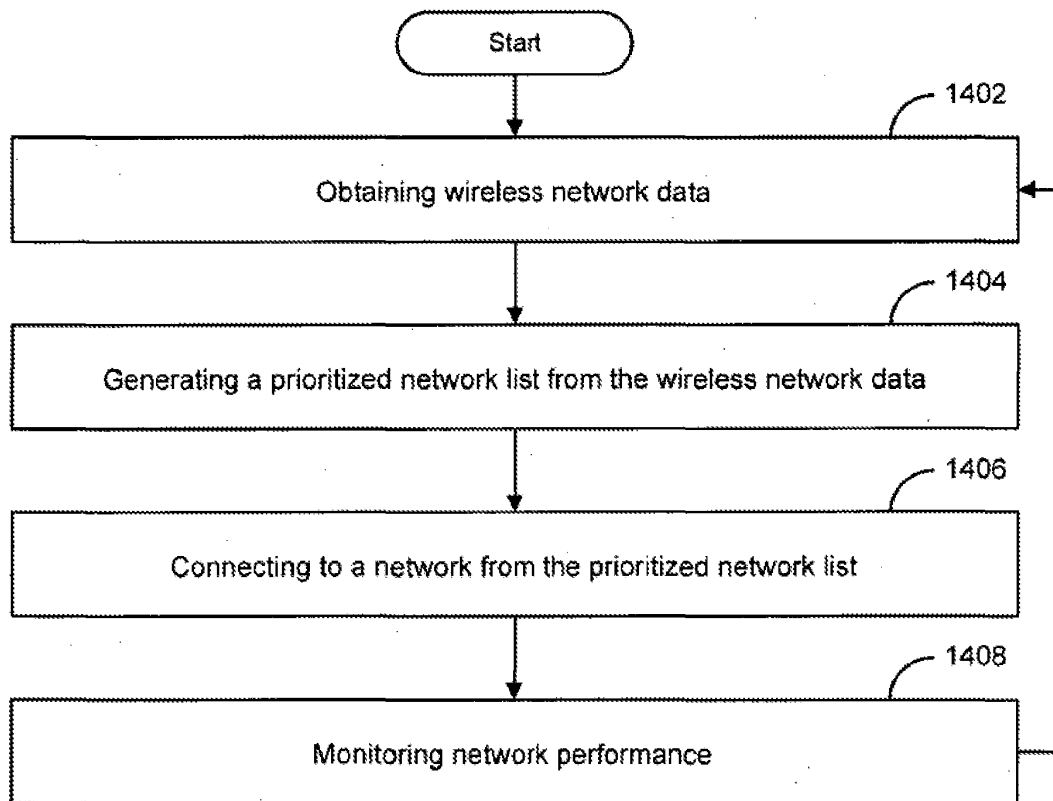


FIG. 14

1500 →

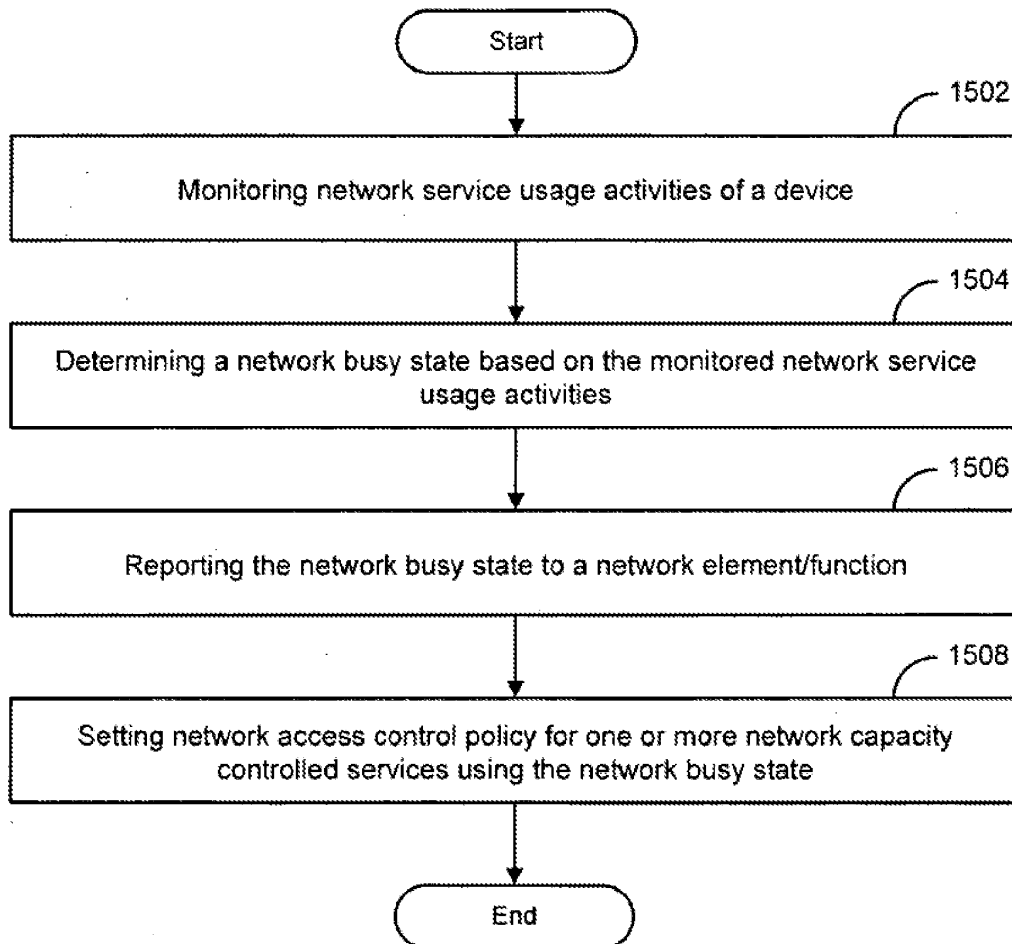


FIG. 15

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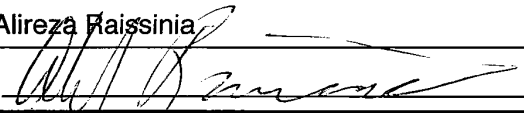
**DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN
APPLICATION DATA SHEET (37 CFR 1.76)**

Title of Invention	System and Method for Wireless Network Offloading (RALEP049D1)
<p>As the below named inventor, I hereby declare that:</p> <p>This declaration is directed to: ☐ The attached application, or ☒ United States application or PCT international application number <u>14/156,428</u> filed on <u>January 15, 2014</u>.</p> <p>The above-identified application was made or authorized to be made by me.</p> <p>I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.</p> <p>I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.</p> <p style="text-align: center;">WARNING:</p> <p>Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.</p> <p>LEGAL NAME OF INVENTOR</p> <p>Inventor: <u>James Lavine</u> Date (Optional): <u>1/24/14</u></p> <p>Signature: <u></u></p> <p>Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.</p>	

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

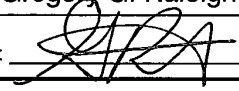
**DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN
APPLICATION DATA SHEET (37 CFR 1.76)**

Title of Invention	System and Method for Wireless Network Offloading (RALEP049D1)
<p>As the below named inventor, I hereby declare that:</p> <p>This declaration is directed to: ☐ The attached application, or ☒ United States application or PCT international application number <u>14/156,428</u> filed on <u>January 15, 2014</u>.</p> <p>The above-identified application was made or authorized to be made by me.</p> <p>I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.</p> <p>I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.</p> <p style="text-align: center;">WARNING:</p> <p>Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.</p>	
<p>LEGAL NAME OF INVENTOR</p> <p>Inventor: <u>Alireza Raissinia</u> Date (Optional): <u>JAN-24-2014</u></p> <p>Signature: <u></u></p>	
<p><small>Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.</small></p>	

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

**DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN
APPLICATION DATA SHEET (37 CFR 1.76)**

Title of Invention	System and Method for Wireless Network Offloading (RALEP049D1)
<p>As the below named inventor, I hereby declare that:</p> <p>This declaration is directed to: ☐ The attached application, or ☒ United States application or PCT international application number <u>14/156,428</u> filed on <u>January 15, 2014</u>.</p> <p>The above-identified application was made or authorized to be made by me.</p> <p>I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.</p> <p>I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.</p> <p style="text-align: center;">WARNING:</p> <p>Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.</p>	
<p>LEGAL NAME OF INVENTOR</p> <p>Inventor: <u>Gregory G. Raleigh</u> Date (Optional) : _____</p> <p>Signature:  _____</p>	
<p><small>Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.</small></p>	

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY DOCKET NO	TOT CLAIMS	IND CLAIMS
15/369,542	12/05/2016	2642	0.00	RALEP049D1C1	1	1

CONFIRMATION NO. 6887

FILING RECEIPT



106963
Headwater Partners I LLC
1011 Pruitt Place
Tyler, TX 75703

Date Mailed: 12/15/2016

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

Gregory G. Raleigh, Woodside, CA;
Alireza Raissinia, Monte Sereno, CA;
James Lavine, Corte Madera, CA;

Applicant(s)

Headwater Partners I LLC, Tyler, TX;

Power of Attorney: The patent practitioners associated with Customer Number 106963

Domestic Priority data as claimed by applicant

This application is a CON of 14/156,428 01/15/2014 PAT 9532261
which is a DIV of 13/134,005 05/25/2011 PAT 8635335
which is a CIP of 12/380,778 03/02/2009 PAT 8321526
and is a CIP of 12/380,780 03/02/2009 PAT 8839388
and claims benefit of 61/348,022 05/25/2010
and claims benefit of 61/381,159 09/09/2010
and claims benefit of 61/381,162 09/09/2010
and claims benefit of 61/384,456 09/20/2010
and claims benefit of 61/385,020 09/21/2010
and claims benefit of 61/387,243 09/28/2010
and claims benefit of 61/387,247 09/28/2010
and claims benefit of 61/389,547 10/04/2010
and claims benefit of 61/407,358 10/27/2010
and claims benefit of 61/418,507 12/01/2010
and claims benefit of 61/418,509 12/01/2010
and claims benefit of 61/420,727 12/07/2010
and claims benefit of 61/422,565 12/13/2010

page 1 of 4

and claims benefit of 61/422,572 12/13/2010
and claims benefit of 61/422,574 12/13/2010
and claims benefit of 61/435,564 01/24/2011
and claims benefit of 61/472,606 04/06/2011
and said 12/380,778 03/02/2009
claims benefit of 61/206,354 01/28/2009
and claims benefit of 61/206,944 02/04/2009
and claims benefit of 61/207,393 02/10/2009
and claims benefit of 61/207,739 02/13/2009
and said 12/380,780 03/02/2009
claims benefit of 61/206,354 01/28/2009
and claims benefit of 61/206,944 02/04/2009
and claims benefit of 61/207,393 02/10/2009
and claims benefit of 61/207,739 02/13/2009

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see <http://www.uspto.gov> for more information.) - None.

Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 12/13/2016

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 15/369,542**

Projected Publication Date: To Be Determined - pending completion of Missing Parts

Non-Publication Request: No

Early Publication Request: No

**** SMALL ENTITY ****

Title

System and Method for Wireless Network Offloading

Preliminary Class

455

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

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Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international

page 2 of 4

patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at <http://www.uspto.gov/web/offices/pac/doc/general/index.html>.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, <http://www.stopfakes.gov>. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

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Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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page 3 of 4

Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign Assets Control, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/369,542	12/05/2016	Gregory G. Raleigh	RALEP049D1C1

106963
Headwater Partners I LLC
1011 Pruitt Place
Tyler, TX 75703

CONFIRMATION NO. 6887
FORMALITIES LETTER



0000000087874320

Date Mailed: 12/15/2016

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

Filing Date Granted

Items Required To Avoid Abandonment:

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The statutory basic filing fee is missing.
- The application search fee must be submitted.
- The application examination fee must be submitted.
- Surcharge as set forth in 37 CFR 1.16(f) must be submitted.

The surcharge is due for any one of:

- late submission of the basic filing fee, search fee, or examination fee,
- late submission of inventor's oath or declaration,
- filing an application that does not contain at least one claim on filing, or
- submission of an application filed by reference to a previously filed application.

SUMMARY OF FEES DUE:

The fee(s) required within **TWO MONTHS** from the date of this Notice to avoid abandonment is/are itemized below. Small entity discount is in effect. If applicant is qualified for micro entity status, an acceptable Certification of Micro Entity Status must be submitted to establish micro entity status. (See 37 CFR 1.29 and forms PTO/SB/15A and 15B.)

- \$ **70** basic filing fee.
- \$ **70** surcharge.
- \$ **300** search fee.
- \$ **360** examination fee.
- \$(**0**) previous unapplied payment amount.
- \$ **800** TOTAL FEE BALANCE DUE.

Replies must be received in the USPTO within the set time period or must include a proper Certificate of Mailing or Transmission under 37 CFR 1.8 with a mailing or transmission date within the set time period. For more information and a suggested format, see Form PTO/SB/92 and MPEP 512.

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<https://portal.uspto.gov/authenticate/AuthenticateUserLocalEPF.html>

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/bzewdie/

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875						Application or Docket Number 15/369,542				
APPLICATION AS FILED - PART I										
(Column 1)		(Column 2)		SMALL ENTITY		OR OTHER THAN SMALL ENTITY				
FOR	NUMBER FILED	NUMBER EXTRA	RATE(\$)	FEE(\$)		RATE(\$)	FEE(\$)			
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	70		N/A				
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A	300		N/A				
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	360		N/A				
TOTAL CLAIMS (37 CFR 1.16(i))	1	minus 20 = *	x 40 =	0.00	OR					
INDEPENDENT CLAIMS (37 CFR 1.16(h))	1	minus 3 = *	x 210 =	0.00						
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			0.00						
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0.00						
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	730		TOTAL				
APPLICATION AS AMENDED - PART II										
(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY		OR OTHER THAN SMALL ENTITY		
AMENDMENT A		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)
	Total (37 CFR 1.16(i))	*	Minus	**	=	x	=	OR	x	=
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x	=	OR	x	=
	Application Size Fee (37 CFR 1.16(s))							OR		
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	
AMENDMENT B		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)
	Total (37 CFR 1.16(i))	*	Minus	**	=	x	=	OR	x	=
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x	=	OR	x	=
	Application Size Fee (37 CFR 1.16(s))							OR		
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	
<div style="font-size: x-small;"> * If the entry in column 1 is less than the entry in column 2, write "0" in column 3. ** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20". *** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3". The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1. </div>										

AMENDMENTS TO THE CLAIMS

1. (Canceled).
2. (New) A wireless end-user device comprising:
 - a radio configured to identify available wireless networks, the available wireless networks being different than a current wireless network to which the end user device is currently connected; and
 - a prioritized network selection engine configured to
 - select one of the available wireless networks based on a prioritized network list,
 - cause the wireless end-user device to connect through the selected available wireless network to a network element in a second network reachable through the selected available wireless network,
 - initiate an upload and/or download sequence between the wireless end-user device and the network element,
 - characterize performance of the selected available wireless network based on the conducted upload and/or download sequence, and
 - determine, based at least in part on the characterized performance, to communicate network data for the wireless end-user device through the selected available wireless network instead of the current wireless network.
3. (New) The wireless end-user device of claim 2, configured to receive the prioritized network list from a remote server.
4. (New) The wireless end-user device of claim 2, configured to supply information based on the characterized performance to an access network characterization server that collects such information from a plurality of wireless end-user devices.
5. (New) The wireless end-user device of claim 2, wherein the prioritized network selection engine configured to cause the wireless end-user device to connect through the selected available

wireless network comprises configured to automatically cause the wireless end-user device to connect through the selected available wireless network.

6. (New) The wireless end-user device of claim 2, wherein the prioritized network selection engine configured to cause the wireless end-user device to connect through the selected available wireless network comprises configured to cause the wireless end-user device to connect through the selected available wireless network in response to a user selection.

7. (New) The wireless end-user device of claim 2, wherein the prioritized network selection engine configured to cause the wireless end-user device to connect through the selected available wireless network comprises configured to automatically cause the wireless end-user device to connect through the selected available wireless network based on one or more user preferences.

8. (New) The wireless end-user device of claim 2, the prioritized network selection engine further configured to provide a user of the wireless end-user device with a notification including an incentive offer to incent the user to connect to one of the available wireless networks.

9. (New) The wireless end-user device of claim 8, wherein the incentive offer includes a network-performance incentive.

10. (New) The wireless end-user device of claim 2, wherein the radio comprises a WiFi radio.

11. (New) The wireless end-user device of claim 10, further comprising a cellular radio, and wherein at a time that the WiFi radio identifies available wireless networks, the current wireless network is a cellular wireless network.

REMARKS

Claim 1 has been canceled, and new claims 2-11 have been added. No new matter has been added. Applicant respectfully requests the entry of the amendments herein.

Applicant is also submitting the required fees and surcharge, as noted in the Notice.

The Commissioner is authorized to charge any fee deficiency or credit any overpayment to Deposit Account 50-5876.

Respectfully submitted,

Date: March 15, 2017

By: /James E. Harris/

James E. Harris
Reg. No. 40,013
Patent Counsel
Headwater Research LLC
1011 Pruitt Place
Tyler, TX 75703
(512) 970-9135

CERTIFICATE OF ELECTRONIC TRANSMISSION

I hereby certify that this paper (along with any paper referred to as being attached or enclosed) is being filed electronically via EFS-Web addressed to the Commissioner for Patents on:

Date: March 15, 2017

By: /Ann Taylor/

Ann Taylor



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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/369,542	12/05/2016	Gregory G. Raleigh	RALEP049D1C1

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Headwater Partners I LLC
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CONFIRMATION NO. 6887
FORMALITIES LETTER



0C000000087874320

Date Mailed: 12/15/2016

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- The application search fee must be submitted.
- The application examination fee must be submitted.
- Surcharge as set forth in 37 CFR 1.16(f) must be submitted.

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<https://portal.uspto.gov/authenticate/AuthenticateUserLocalEPF.html>

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/bzewdie/

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Raleigh et al.	Examiner: not yet assigned
Serial No.: 15/369,542	Art Unit:
Filed: December 5, 2016	Conf. No.: 6887
Title: System and Method for Wireless Network Offloading	

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

INFORMATION DISCLOSURE STATEMENT

The references cited on attached form PTO/SB/08A are being called to the attention of the Examiner. Copies of the references are not enclosed.

In accordance with 37 CFR §1.98(d), copies of the references can be found in related U.S. Patent Application No. 14/156,428 filed January 15, 2014 or in Patent Application No. 13/134,005 filed May 25, 2011, of which the instant application is from the same direct family. Any foreign or non-patent references not submitted in those family applications are transmitted herewith.

It is respectfully requested that the cited references be expressly considered during the prosecution of this application, and the references be made of record therein and appear among the “references cited” on any patent to issue therefrom.

As provided for by 37 CFR § 1.97(g) and (h), no inference should be made that the information and references cited are prior art merely because they are in this statement and no

representation is being made that a search has been conducted or that this statement encompasses all the possible relevant information.

Applicant believes that no fee is required for submission of this statement, but if for any reason an insufficient fee has been paid, please charge the insufficiency to Deposit Account No. 50-5876.

Respectfully submitted,

Date: March 15, 2017

By: /James E. Harris/

James E. Harris
Reg. No. 40013
Headwater Research LLC
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	Filing Date		2016-12-05
	First Named Inventor	Raleigh et al.	
	Art Unit		
	Examiner Name	not yet assigned	
	Attorney Docket Number	RALEP049D1C1	

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Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
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	2	8165576		2012-04-24	Raju, Vishwanath et al.	
	3	8073721		2011-12-06	Lewis, Lundy	
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Signature	/James E. Harris/	Date (YYYY-MM-DD)	2017-03-15
Name/Print	James E. Harris	Registration Number	40013
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	Examiner Name	not yet assigned
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Name/Print	James E. Harris	Registration Number	40013
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A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.			
Signature	/James E. Harris/	Date (YYYY-MM-DD)	2017-03-15
Name/Print	James E. Harris	Registration Number	40013
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Signature	/James E. Harris/	Date (YYYY-MM-DD)	2017-03-15
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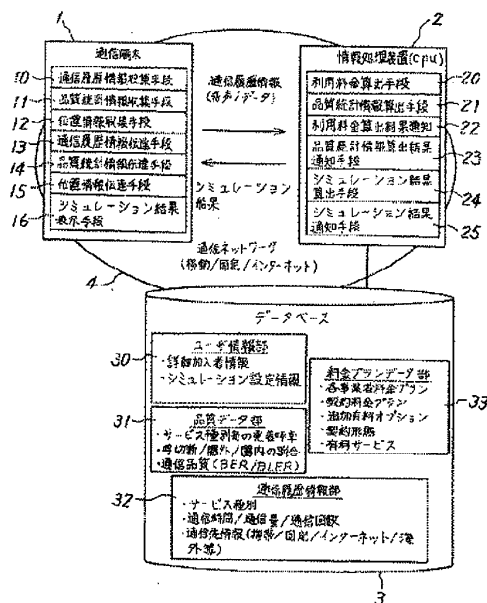
APPLICANT : FUJITSU LTD;

INVENTOR : KATAOKA KOSUKE;

INT.CL. : H04M 15/16 (2006.01)

TITLE : CHARGING PLAN NOTIFICATION SYSTEM

本発明の構成図



ABSTRACT : PROBLEM TO BE SOLVED: To provide a charging plan notification system for calculating the lowest optimum charging plan corresponding to a utilization state of a communication terminal user from charging plans provided by all carriers.

SOLUTION: The charging plan notification system is provided with: a communication terminal for transmitting communication history information concerned with communication; a database 3 for storing the communication history information, all contract information between communication terminal users and communication carriers and all charging plans for communication service provided by all the carriers; and an information processor 2 for calculating utilization charges. The information processor 2 respectively calculates accurate utilization charges in the charging plans provided from respective carriers on the basis of the communication history information of each communication terminal user, the contract information and all the charging plans and notifies the communication terminal user of the calculated results.

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最終頁に続く

(54) 【発明の名称】 料金プラン通知装置

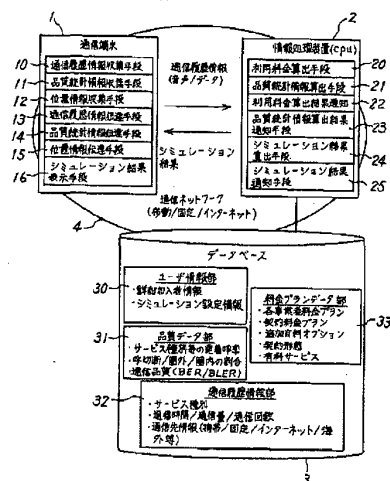
(57) 【要約】

【課題】全通信事業者の料金プランの中から通信端末ユーザの利用状態に応じた最も安い最適の料金プランを算出する料金プラン通知装置を提供すること。

【解決手段】このため本発明では、通信に関する通信履歴情報を送信する通信端末1と、通信履歴情報と、通信端末ユーザの通信事業者との全ての契約情報と、全通信事業者が提供する通信サービスの全料金プランとを蓄積しておくデータベース3と、利用料金を算出する情報処理装置2を具備する料金プラン通知装置であって、通信端末ユーザの通信履歴情報と、契約情報と、全料金プランとの情報を利用し、情報処理装置2により各通信事業者が提供している料金プランにおいて、各々正確な利用料金を算出し、通信端末ユーザに通知する。

【選択図】図1

本発明の構成図



【特許請求の範囲】

【請求項1】

通信に関する通信履歴情報を送信する通信端末と、
通信履歴情報と、通信端末ユーザの通信事業者との全ての契約情報と、全通信事業者が提供する通信サービスの全料金プランとを蓄積しておくデータベースと、
利用料金を算出する情報処理装置を具備する料金プラン通知装置であって、
通信端末ユーザの通信履歴情報と、契約情報と、全料金プランとの情報を利用し、情報処理装置により各通信事業者が提供している料金プランにおいて、各々正確な利用料金を算出し、通信端末ユーザに通知する料金プラン通知装置。

【請求項2】

前記通信端末は、全通信における発着呼率、通信途中での切断、待受け時における圏内・圏外の割合、データ伝送速度等、全ての品質情報を通信履歴情報、通信端末が取得できる位置情報とをデータベースに送信する伝達手段を持ち、
上記データベースは品質情報を蓄積する蓄積手段を持ち、
上記情報処理装置は、品質情報を基に各通信事業者、エリア、時間帯毎等の統計的な通信サービスの品質情報を算出する算出手段を持ち、通信サービスの品質情報を全料金プランの正確な利用料金と共に通信端末ユーザに通知できる通知手段を具備したことを特徴とする請求項1記載の料金プラン通知装置。

【請求項3】

上記情報処理装置は、予めデータベースに登録されている、通信端末ユーザが通信事業者と契約している料金プラン、追加有料オプション、契約時期、契約形態、有料サービス、全通信事業者が提供している全料金プラン、及び有料オプション、割引情報等の情報を利用して正確な利用料金を算出することを特徴とする請求項1記載の料金プラン通知装置。

【請求項4】

上記情報処理装置は、サービス種別、通信時間、量、回数、通信先、位置情報等の詳細な通信履歴情報を利用して、正確な利用料金を算出することを特徴とする請求項1記載の料金プラン通知装置。

【請求項5】

通信端末ユーザが利用を想定した任意の利用条件をデータベースに設定し、ユーザの要求に応じて情報処理装置は、それらの情報と、データベースに登録してある通信端末ユーザの詳細加入者情報及び料金プランに関連する情報を利用して、各料金プランにおいてシミュレーションし、正確に料金算出し、結果を通信端末ユーザに通知することを特徴とする請求項1記載の料金プラン通知装置。

【発明の詳細な説明】

【技術分野】

【0001】

本発明は、通信端末の利用料金を算出し、通信端末ユーザに通知するサービスを行う料金プランを考慮した料金シミュレーションを実施し、最適な料金プランをユーザおよび事業者に通知する料金プラン通知システムに関する。

【背景技術】

【0002】

従来、携帯電話の如き通信端末では、基本使用料と一定金額の無料通話分の設定や、平日昼間や夜間、土日祝日等通話時間帯毎の通話料割引倍率、パケット料金の割引など様々な割引プランが設定されている。

【0003】

通信事業者は、これらの組み合わせによりバリエーションを持たせた料金プランを準備している。

【0004】

ユーザは、あらかじめ1つの料金プランを選択し、そのプランに設定された割引率と実

際の月々の利用料金により算出された金額を契約した通信事業者からの請求により支払う。

【0005】

ユーザが自己の通信に対して最適な料金プランによる通信サービスを受けることができるように、ユーザに対して通話終了毎に、契約された契約料金プランと準備された全ての料金プランとを比較して、得られる最適な料金プランをリアルタイムで通知することが提案されている。

【特許文献1】特開2001-36673号公報

【発明の開示】

【発明が解決しようとする課題】

【0006】

上記従来技術では、ユーザが現在契約している通信事業者が提供しているサービスの中における最適な料金プランの提供であり、他社の通信事業者の提供しているものを含めた料金プランにおける最適なものの提供ではない。

【0007】

したがってユーザが、現在契約している料金システムが自己にとって最適なプランであるかどうかを判断するために、ユーザ自身が月々の利用状態を分析し、検討し、現在の契約通信事業者のみならず他の契約通信事業者の料金プランと比較することが必要である。

【0008】

しかるに各社の料金プランは多様・複雑化しており、ユーザ自らが分析・検討するのは困難である。したがって、各社の料金プランの中からユーザの通信端末の利用状態に応じた、最適の料金プランを提供するサービスが求められている。

【課題を解決するための手段】

【0009】

上記課題を解決するため、本発明では、下記(1)～(5)の料金プラン通知装置を提供する。

【0010】

(1) 通信に関する通信履歴情報を送信する通信端末と、通信履歴情報と、通信端末ユーザの通信事業者との全ての契約情報と、全通信事業者が提供する通信サービスの全料金プランとを蓄積しておくデータベースと、利用料金を算出する情報処理装置を具備する料金プラン通知装置であって、通信端末ユーザの通信履歴情報と、契約情報と、全料金プランとの情報を利用し、情報処理装置により各通信事業者が提供している料金プランにおいて、各々正確な利用料金を算出し、通信端末ユーザに通知することを特徴とする料金プラン通知装置。

【0011】

(2) 上記(1)の料金プラン通知装置において、前記通信端末は、全通信における発着呼率、通信途中での切断、待受け時における圏内・圏外の割合・データ伝送速度等、全ての品質情報を通信履歴情報、通信端末が取得できる位置情報とをデータベースに送信する伝達手段を持ち、上記データベースは品質情報を蓄積する蓄積手段を持ち、上記情報処理装置は、品質情報を基に各通信事業者、エリア、時間帯毎等の統計的な通信サービスの品質情報を算出する算出手段を持ち、通信サービスの品質情報を全料金プランの正確な利用料金と共に通信端末ユーザに通知できる通知手段を具備したことを特徴とする。

【0012】

(3) 上記(1)の料金プラン通知装置において、上記情報処理装置は、予めデータベースに登録されている、通信端末ユーザが通信事業者と契約している料金プラン、追加有料オプション、契約時期、契約形態、有料サービス、全通信事業者が提供している全料金プラン、及び有料オプション、割引情報等の情報を利用して正確な利用料金を算出することを特徴とする。

【0013】

(4) 上記(1)の料金プラン通知装置において、上記情報処理装置は、サービス種別

、通信時間、量、回数、通信先、位置情報等の詳細な通信履歴情報を利用して、正確な利用料金を算出することを特徴とする。

【0014】

(5) 上記(1)の料金プラン通知装置において、通信端末ユーザが利用を想定した任意の利用条件をデータベースに設定し、ユーザの要求に応じて情報処理装置は、それらの情報と、データベースに登録してある通信端末ユーザの詳細加入者情報及び料金プランに関連する情報を利用して、各料金プランにおいてシミュレーションし、正確に料金算出し、結果を通信端末ユーザに通知することを特徴とする。

【発明の効果】

【0015】

本発明により下記の効果を奏する。

【0016】

(1) 通信端末が通信端末ユーザの詳細な通信履歴情報をサービス提供者の料金プラン通知装置のデータベースに登録し、情報処理装置において、前記データベースに登録された詳細な通信履歴情報と料金プラン情報を使用して、ユーザが契約していない他の通信事業者のプランも含めて全料金プランについて正確な通信料金を算出し、通信端末ユーザに通知するので、通信端末ユーザは前記契約外の通信事業者のプランも含めた一番安い料金プランを正確に知ることができる。

【0017】

(2) 通信端末に、通信履歴情報と共に通話品質に関連する情報をサービス提供者の料金プラン通知装置のデータベースに送信し、情報処理装置に、データベースに登録されている通信品質に関連する情報を使用して各通信事業者、エリア、時間帯毎等の統計的な通信サービスの品質情報を算出し、通信端末ユーザに通知するので、通信端末ユーザは契約していない通信事業者のつながり易さ、音声品質等の通信品質を含め、全通信事業者の通信品質情報を知る事が出来るので、通信端末ユーザは、一番通信品質の良い通信事業者を選択することができる。

【0018】

(3) 通信端末ユーザは、料金プランや契約形態等の詳細な加入者情報、契約情報をサービス提供者の料金プラン通知装置のデータベースに登録し、それらを利用料金算出に使用することにより、利用形態に沿った正確な一番安い利用料金プランを算出することが可能となる。

【0019】

(4) 現在の通信端末は音声通話終話単位で表示される通信履歴情報とパケット数情報を確認できるが、これらは各通信事業者の標準的なプランを基にした情報であり必ずしも正確な情報ではなかったが、本発明では通信端末ユーザからの実用的な詳細情報の収集は、通話時間、パケット数だけでなく、通信量、通話回数、接続通話先、データ量、利用回数等通信履歴情報の詳細を用いてデータベースに登録し、それらを利用料金算出に使用できるので、情報処理装置での正確な利用料金算出を可能とする。

【0020】

(5) 通信端末ユーザが自分の利用形態を想定した条件をデータベースに登録し、データベースに登録した詳細な加入者情報、各種料金プランを利用することで大雑把な料金シミュレーションではなく、正確なシミュレーションの実現が可能となり、また前月の履歴情報を流用する手段を持たせることで、シミュレーションに必要な情報を前月と同じ状態で算出することができ、ユーザオペレーションを低減させた正確なシミュレーションの実現が可能となる。

【発明を実施するための最良の形態】

【0021】

自己の通信履歴情報を、サービス業者に送信する通信端末と、多数の通信事業者の料金プランと前記通信履歴情報を保持するデータベースと、前記通信履歴情報にもとづき前記多数の通信事業者の料金プランを使用して通信を行ったときの料金を算出する情報処理装

置を設け、前記通信履歴情報にもとづき前記多数の通信事業者の料金プランを使用して通信を行ったときもっとも安いものを前記情報処理装置で算出して、このうちのもっとも安い料金システムを通信端末ユーザに通知する料金プラン通知装置を提供する。これにより、通信端末ユーザは、このサービス業者からの通知により、自己が契約している通信事業者以外の他の通信事業者を含めた全通信事業者の料金プランのうちより、自己に適したもっとも安い料金プランを認識することができる。

【実施例】

【0022】

本発明の実施例1を図1～図3にもとづき説明する。図1は本発明の構成図、図2は本発明の品質統計情報説明図、図3は時間毎の品質統計情報説明図である。

【0023】

図中、1は通信端末、2は情報処理装置、3はデータベース、4は通信ネットワーク、10は通信履歴情報収集手段、11は品質統計情報収集手段、12は位置情報収集手段、13は通信履歴情報伝達手段、14は品質統計情報伝達手段、15は位置情報伝達手段、16はシミュレーション結果表示手段、20は利用料金算出手段、21は品質統計情報算出手段、22は利用料金算出結果通知手段、23は品質統計情報算出結果通知手段、24はシミュレーション結果算出手段、25はシミュレーション結果通知手段、30はユーザ情報部、31は品質データ部、32は通信履歴情報部、33は料金プランデータ部である。

【0024】

通信端末1は、ユーザが通信相手と音声やデータを送受信するものであり、例えば携帯端末である。

【0025】

情報処理装置2は、通信端末1から送信された通信履歴情報と、データベース3に保持された多くの通信事業者A、B、C・・・の料金プランデータに基づいてシミュレーション演算を行い、そのうちもっとも安いものを送出するものであり、CPUで構成される。

【0026】

データベース3は通信端末1から送信された通信履歴情報や、多くの通信事業者A、B、C、Dの料金プランデータが保持されており、外部メモリで構成されている。そしてデータベース3と情報処理装置2はサービス提供者側の料金プラン通知装置に設置されている。

【0027】

通信ネットワーク4は、移動端末用ネットワーク、固定端末用ネットワーク、インターネットの如き、通信ネットワークである。

【0028】

通信端末1には、通信履歴情報収集手段10、品質統計情報収集手段11、位置情報収集手段12、通信履歴情報伝達手段13、品質統計情報伝達手段14、位置情報伝達手段15、シミュレーション結果表示手段16等を有する。

【0029】

通信履歴情報収集手段10は、通信端末1が通信相手に送信した送信データの種別データ量、送信時刻、送信時間、サービス種別等の履歴情報を一定期間保持するものである。

【0030】

品質統計情報収集手段11は、通信相手から受信したデータの品質を通信相手が使用している通信事業者A、B、C・・・毎に、例えば公知の5段階評価し、これを保持するものである。

【0031】

品質情報は、例えば前記受信データの5段階評価の外に、発着呼率、通信途中での切断、圏内・圏外の割合、通信品質（ビットエラーレートBER、ブロックエラーレートBLER）、データ伝送レート等である。

【0032】

品質情報の例を図2、図3に示す。図2、図3は、通信事業者A、B、C、Dの4者における品質統計情報を示すもので、図2(A)は各通信事業者の平均の呼接続率、圏内の割合を示し、図2(B)は各通信事業者の平均の通信品質を示し、図2(C)は各通信事業者の平均データ伝送レートを示し、図3は各通信事業者の時間毎の呼接続率、圏内の割合を示す図である。

【0033】

なお図2(A)における呼接続率(平均)M1と圏内の割合(平均)M2は下式により算出されるものである。

【0034】

$M1 = (\text{完了呼} - \text{不完了呼}) / \text{発呼}$

$M2 = (\text{圏内の時間} - \text{圏外の時間}) / \text{電源を入れていた時間}$

図2、図3のデータは、サービス業者に加入している通信事業者A、B、C、Dを利用しているユーザの通信端末より送信されたデータにもとづく統計情報である。

【0035】

図2(A)に示す如く、呼接続率は通信事業者Aが約90%、通信事業者Bが約95%、通信事業者Cが約80%、通信事業者Dが約98%であることを示す。またノイズの少ない安定した状態で通信可能であることを示す圏内の割合は通信事業者Aが約95%、通信事業者Bが約76%、通信事業者Cが約85%、通信事業者Dが約97%であることを示す。

【0036】

通信品質は、5段階評価で通信事業者A、B、Dが5、通信事業者Cが4であることを示し、平均データ伝送レートは通信事業者Aが約25kbps、通信事業者Bが約17kbps、通信事業者Cが約23kbps、通信事業者Dが約24kbpsであることを示す。

【0037】

品質情報には通信端末ユーザの住所が記入されているので、サービス装置側では各通信事業者についてこれらの住所を解析することにより例えば通信事業者Cが横浜駅周辺では通信品質があまりよくない等の品質統計情報を得ることができ、このような情報をユーザに提供することもできる。

【0038】

位置情報収集手段12はサービス業者を利用している通信端末ユーザと通信先の通信端末ユーザの位置情報(住所)を収集し、これを保持するものである。

【0039】

通信履歴情報伝達手段13は、通信履歴情報収集手段10が収集した通信端末1が行った通信データを、通信ネットワーク4を経由してサービス業者側の情報処理装置2に送出するものである。

【0040】

品質統計情報伝達手段14は、品質統計情報収集手段11が収集したデータの品質情報をサービス業者側の情報処理装置2に通信ネットワーク4を経由して送出するものである。

【0041】

位置情報伝達手段15は、位置情報収集手段12で収集した、通信端末1と通信した相手端末のユーザの位置情報(住所)を通信ネットワーク4を経由してサービス業者側の情報処理装置2に送出するものである。

【0042】

シミュレーション結果表示手段16は、情報処理装置2が算出したシミュレーション結果が通信ネットワーク4を経由して通信端末1に伝達されたとき、これを通信端末ユーザに表示する表示手段である。

【0043】

情報処理装置2は、通信端末から送信された通信履歴情報とデータベース4に蓄積され

ている全通信事業者の料金プランを使用して、全通信事業者の各料金プランについて正確な通信料金を算出し、通信端末の要求に応じて算出した通信料金を通信端末に通知したり、通信端末から受信した通信品質情報をデータベースに送信したり、データベースに登録してある通信品質情報を使用し、地域、時間帯通信事業者毎に品質統計情報を算出し通信端末の要求に応じて品質統計情報を通信端末に通知するものである。

【0044】

このため、情報処理装置2には、利用料金算出手段20、品質統計情報算出手段21、利用料金算出結果通知手段22、品質統計情報算出結果通知手段23、シミュレーション結果算出手段24、シミュレーション結果通知手段25等を有する。

【0045】

利用料金算出手段20は、通信端末1から伝達された音声、データ等の通信履歴情報や、データベース部3に保持された各通信事業者の料金プランを使用して通信端末1のユーザに対する利用料金を算出するものである。

【0046】

品質統計情報算出手段21は、通信端末1から受信されデータベース3に登録した通信品質情報を使用し、地域、時間帯、通信事業者毎における発着呼率、通信品質情報等を算出し、通信端末1の要求に応じて品質統計情報を通信端末1に通知するものである。

【0047】

利用料金算出結果通知手段22は、利用料金算出手段20で算出された全通信事業者の料金プランにもとづく通信料金のうち、もっとも安い料金を通信端末1に通知するものである。

【0048】

シミュレーション結果算出手段24は、通信端末1のユーザが指定した任意の利用条件にもとづき、各通信事業者の料金プランを使用してもっとも安い利用料金を算出するものである。

【0049】

シミュレーション結果通知手段25は、このシミュレーション結果算出手段24から通知されたシミュレーション結果を、シミュレーション要求を行った通信端末に対し通知するものである。

【0050】

データベース3は、通信事業者に対する通信端末の加入者の詳細な契約情報、全通信事業者が提供する各種料金プラン、追加有料オプション情報、割引情報等の全ての課金に関する情報、及び本発明のサービスを制御するための、通信料金の通知回数や通知するタイミング等の設定情報、通信端末が送信した通信履歴情報を蓄積するもので、ユーザ情報部30、品質データ部31、通信履歴情報部32、料金プランデータ部33等を有し、前記情報処理装置2とともにサービス業者の料金プラン通知装置を構成する。

【0051】

ユーザ情報部30は、通信端末1の加入者が現在契約している通信業者との詳細な契約情報である詳細加入者情報や、この加入者が料金のシミュレーション演算を求めるシミュレーション設定情報を保持するものである。

【0052】

品質データ部31は、通信端末より送出されるサービス種別毎の発着呼率、呼切断の割合、圏内と圏外の割合、ビットエラーレート（BER）、ブロックエラーレート（BLER）等の通信品質を保持するものである。

【0053】

通信履歴情報部32は、通信端末より伝達された、通信端末が実際に通信を行った結果の情報を保持するもので、サービス種別、通信時間、通信量、通信回数、通信先が携帯端末か、固定端末か、インターネットか、海外か等を示す通信先情報を保持するものである。

【0054】

料金プランデータ部33は、通信端末が加入しているか否かにかかわらず、全通信事業者の提供する各事業者料金プラン、契約料金プラン、追加有料オプション、契約形態、有料サービス等の課金に関する料金データを保持するものである。これらの料金データは、通信事業者がインターネットで公開したり、通信端末販売業者に郵送したりしているので、容易に入手できるものである。

【0055】

実施例1において、通信端末1は、通信履歴情報収集手段10が収集したこの通信端末1が実際に通信した通信履歴情報を、通信履歴情報伝達手段13が電子情報に変換し、移動通信網、固定通信網、インターネットの如き通信ネットワーク4を経由して、サービス業者の料金プラン通知装置を構成する情報処理装置2に送信する。

【0056】

情報処理装置2では、これを受信し、データベース3の通信履歴情報部32に通信端末毎に、サービス種別、通信時間、通信量、通信回数、通信先情報等に識別して保持する。

【0057】

なお、サービス業者の料金プラン通知装置のデータベース3には、通信端末の加入者の料金プラン、オプション、契約期間等の詳細加入者情報やシミュレーション設定情報がそのユーザ情報部30に保持され、また各通信事業者の料金プラン、契約料金プラン、追加有料オプション、契約形態、有料サービス等が料金プランデータ部33に保持されている。

【0058】

したがって、通信端末の加入者が、例えば過去1ヶ月の通信履歴情報にもとづき、全通信事業者の料金プランにしたがって料金算出を求めたとき、情報処理装置2では、利用料金算出手段20がデータベース3よりこの加入者の通信端末が過去1カ月に実際に通信を行った履歴情報にもとづき、料金プランデータ部33に保持されている全通信事業者の各料金プランにより料金を算出し、これを利用料金算出結果通知手段22に伝達する。

【0059】

利用料金算出結果通知手段22では、この伝達された料金のうちもっとも安いものを選択してこれを通信端末1に送信する。

【0060】

通信端末1ではこれをシミュレーション結果表示手段16が受信して表示出力し、加入者はこれにより、どの通信事業者の料金プランが自己の過去1ヶ月の通信履歴に対してもっとも安かったか認識し、現在の契約が適切か否かの判定が可能となる。勿論履歴情報は過去1ヶ月ではなく、1週間とか、適宜選択できる。

【0061】

実施例2においては、通信品質情報を算出通知するものである。通信端末1では通信毎の通信品質情報、例えば発着呼率、通信品質、通信時間、位置情報等を品質統計情報収集手段11が算出し、これを収集する。

【0062】

品質統計情報伝達手段14はこれらの情報を電子情報に変換し、任意のタイミングで移動通信網、固定通信網、インターネットの如き通信ネットワーク4を経由して、情報処理装置2に送信する。

【0063】

情報処理装置2は、通信端末1から受信した受信品質情報をデータベース3の品質データ部31に送信し、通信品質情報を蓄積する。

【0064】

そして情報処理装置2は、通信端末1のユーザの要求に応じて、データベース3に登録してある通信品質情報を使用し、その品質統計情報算出手段21が、地域毎、時間帯毎、通信事業者毎に、各時間帯毎、地域毎、事業者毎における発着呼率、呼切断、圏外・圏内の割合、BER、BLER等の通信品質情報等を算出し、通信端末1のユーザの要求に応じて品質統計情報算出結果通知手段23がこの品質統計情報を通信端末1に通知する。通

信端末1はこれをシミュレーション結果表示手段16で受信してユーザに表示する。通信端末1のユーザは例えば図2、図3に示す如き、各通信事業者のサービス品質情報を取得することにより、通信サービスの品質を比較することができる。

【0065】

実施例3においては、有料オプション、契約期間等の詳細な加入者情報と、全通信事業者の提供する全料金プラン、追加オプション、割引制度情報から料金を比較算出するようにしたものである。

【0066】

データベース3のユーザ情報部30には、情報処理装置2が通信端末ユーザの利用料金を算出する際に使用する、データベースに登録されている詳細な加入者情報が保持されている。

【0067】

この詳細な加入者情報としては、通信端末ユーザが通信事業者と契約している料金プラン情報すなわち、月額基本料金、無料通話時間、音声・データ・メール（Eメール、通信事業者網内向けメール、送受信料）等のサービス種別の通信料、自他国内キャリア、海外キャリア、国内・海外の固定電話、通信電話等の通信先毎の通信料、有料オプション、割引情報、契約期間、個人契約、法人契約（複数回線割引）等の契約形態等が登録されている。

【0068】

有料オプションの代表的なものとしては、通信事業者が提供する、留守番電話サービス、三者通話、海外ローミングサービス、国際通話等、その他ニュース、天気情報等の料金や条件等の詳細情報が登録される。

【0069】

割引情報の代表的なものとしては、家族割引、指定番号割引等の特定番号割引、時間帯割引、年齢・学生割引、長期契約割引、パケット割引の如きサービス種別毎の割引等の詳細情報が登録される。

【0070】

また、データベースの料金プランデータ部33には、全通信事業者が提供している全料金プラン及び有料オプション、割引情報等の課金対象サービスの全ての詳細情報、条件が登録されており、これらの情報により情報処理装置2の利用料金算出手段20が、例えば履歴情報に対して正確な利用料金を算出し、通信端末ユーザの契約料金と比較検討することができる。

【0071】

実施例4においては、通信履歴情報の詳細を示す。

【0072】

通信端末1がデータベース3に送信する通信履歴情報には、下記のような通信料金を算出するために必要な詳細情報が含まれている。

【0073】

音声、伝送速度・WEBアクセス・メール等のデータ、動画等のサービス種別。

【0074】

通信時間、パケット数等の量、回数。

【0075】

通信電話又は固定電話・フリーダイヤル・特定番号・URL・Eメール・国内又は海外等の通信先。

【0076】

緯経度等の位置情報。

【0077】

通信端末1は、これらの情報を電子情報に変換し、データベース3に送信する。情報処理装置2ではこれらの情報を利用料金の算出に使用する。

【0078】

実施例5においては、ユーザの任意の設定により、各料金プランにおいて使用料金をシミュレーション可能とするものである。

【0079】

このために、通信端末にユーザが例えば後述するサービス提供者のホームページより利用方法を想定したシミュレーション条件例えば音声通話時間、メール送受信回数、Webアクセス頻度、データ転送頻度、シミュレーション結果通知項目等を情報処理装置2に送信し、データベース3のユーザ情報部30にこれらシミュレーション設定情報を登録する。

【0080】

情報処理装置2では、シミュレーション結果算出手段24がこのシミュレーション条件と、データベース3の料金プランデータ部33に登録済みの全通信事業者の料金プランを利用してシミュレーション結果を算出し、シミュレーション結果通知手段25がそのうちのもっとも安いものを通信端末1に送信し、シミュレーション結果表示手段16がこれを表示してユーザにシミュレーション結果を知らせることができる。

【0081】

シミュレーション条件としてユーザの設定によるもののみでなく、例えばデータベースに蓄積されている前月の使用明細などの以前の通信履歴情報やデータベース3のユーザ情報部30に予め用意してある代表的なシミュレーション条件を利用して設定することもできる。

【0082】

以前の通信履歴情報を利用する場合、本発明の料金プラン通知装置を設置するサービス提供者が作成したホームページの入力フォームにこの通信履歴情報を読み込ませるようにしてもよく、定形のファイルに以前の通信履歴情報を入力して通信端末等に送信し、通信端末は以前の通信履歴情報が記載された定形のファイルを編集し、データベースに送信することによっても実現できる。

【0083】

本発明では、通信端末ユーザは任意の利用条件を指定し、各料金プランにおいて通信料金をシミュレーションすることができる。

【0084】

通信端末は、ホームページの利用など公知の手段を使用して任意の利用条件をデータベースに設定する。任意の利用条件は、データベースに蓄積されている以前の通信履歴情報を流用することも可能である。

【0085】

データベースは通信端末から送信されてくる通信履歴情報を蓄積する。

【0086】

情報処理装置は、通信端末ユーザが指定した任意の利用条件、又はデータベースに蓄積されている以前の通信履歴情報、料金プラン、契約情報、割引情報を使用し、通信料金をシミュレーションし、通信端末ユーザに通知することができる。

【0087】

このシミュレーションとは、過去何時間とか特定の日等任意の期間の利用条件を元に、1ヶ月、1年分等の利用料金を全料金プランにおいて試算できる。これにより通信端末ユーザは種々の利用形態における利用料金を知ることができる。

【0088】

本発明では、通信端末ユーザは、情報処理装置で算出した、各料金プランの正確な使用料金、シミュレーション結果、及びサービス種別、通信先、通信時間、回数、情報量等の個別通信毎の料金内訳、品質統計情報等を下記に示す手段で入手することができる。

(1) 電子データ：情報処理装置は通信端末ユーザの要求に応じて前記算出情報を、データベースから収集し、データファイル(テキスト、HTML形式等)に変換して、Eメール、データファイルを通信端末ユーザのEメールアドレスに送信する。また情報処理装置が前記算出情報をホームページに変換し、通信端末ユーザにホームページのアドレスを送

信し、通信端末ユーザはそのホームページのアドレスにアクセスして閲覧することにより前記情報を見ることができる。また情報処理装置が前記算出情報をデータファイルに変換して通信端末ユーザに送信し、通信端末ユーザはそのデータファイルを閲覧することにより前記算出情報を見ることができる。

【0089】

(2) 前記以外の手段：情報処理装置は通信端末ユーザの要求に応じて、前記算出情報をデータベースから収集し、音声ガイダンスに変換することで通信端末ユーザに聞かせることができる。またその他に、明細書を作成して郵送したり、オペレータによる対応等により通信端末ユーザは前記算出情報を入手することができる。

【0090】

本発明では、通信端末ユーザは、情報処理装置が行う全ての処理、情報を伝送するタイミングを任意に設定することができる。これにより、通信料が安い時間帯での送信や、日、週、月、年単位等のある期間の通信履歴情報を送信するタイミング、自動又は手動、月に何回等の回数を設定することができる。これにより通信端末は、任意のタイミングで通信履歴情報をデータベースに送信することができる。

【0091】

また通信端末は、利用料金をシミュレーションさせるタイミング、シミュレーション結果を通知するタイミング等の各種タイミングをデータベースに登録することができる。

【0092】

情報処理装置は、前記タイミングで利用料金算出、シミュレーションを行い、通信端末ユーザに利用料金や、シミュレーション結果を通知する。

【0093】

本発明では、通信履歴情報や品質情報及び情報処理装置が送信するデータに優先度をつけることができ、これによりトラフィックを制御することができる。

【0094】

通信端末や情報処理装置では、公知の手段によりそれぞれが送信すべきデータの形式を変換して送信することができる。通信事業者は一般的に許容される伝送遅延を、映像>音声>パケットデータ(WE Bアクセス、ファイル転送、Eメール等)の順に設定していることが多いので、通信履歴情報や品質情報、使用料金シミュレーション等の通信端末と情報処理装置で送受信する全ての情報を映像のフォーマットに変換して送れば、遅延時間は最小で送信できるが、その分トラフィックを圧迫することになる。反対にパケットデータに変換して送れば、遅延時間は多くなるが、その分トラフィックの隙間を利用して送信できるので、通信ネットワークのトラフィックに負担をあまりかけないようにできる。

【0095】

本発明では、使用料金算出、シミュレーションや品質情報を提供するのに通信費がかかるので、通信端末ユーザは、使用料金算出やシミュレーションに関連する情報を使用料金算出、シミュレーションする際に料金に含むか、含まないかをデータベースに設定することができる。もし「含まない」を選択した場合、情報処理装置は、純粋な通信にかかった使用料金を算出し、通信端末ユーザに送信する。このように通信端末ユーザは、純粋に通信にかかった料金のみを知ることができる。

【0096】

本発明では、通信端末ユーザは、情報処理装置で算出する通信先、通信時間、回数、情報量等の詳細な通信履歴毎の料金、事業者内・事業者間、比較プラン数、通知プラン数等のシミュレーション結果、料金プラン、通信履歴情報、割引情報等のシミュレーション条件の内容を、ユーザが任意に設定できる。

【0097】

これにより使用料金算出、シミュレーションにかかる通信費や情報処理装置がシミュレーションに要する時間を調整できる。

【0098】

通信端末ユーザは、使用料金算出、シミュレーション結果、シミュレーション条件の項

目のうち、任意の項目をデータベースに設定できる。これにより通信端末ユーザはどこまで正確に使用料金を算出するか設定することができる。当然、条件が多ければ通信履歴情報やシミュレーション結果等のデータ量は多くなり、その分通信費、情報処理装置が処理に要する時間は多くなる。

【0099】

情報処理装置は通信端末ユーザがデータベースに設定された条件を使用して使用料金算出、シミュレーションを行い通信端末ユーザに結果を送信する。

【0100】

本発明では、個人情報の秘密を保護するため、通信端末ユーザが送信する通信履歴情報及び情報処理装置において算出する使用料金算出、シミュレーション結果、品質情報等全てを暗号化して送信することができる。例えば通知端末では公知の暗号化機能を有するソフトを使用することができ、また情報処理装置は自身で暗号化機能を持つ。

【0101】

暗号化・復号化手段には一般に使用されている公開鍵暗号方式、秘密暗号方式等の暗号化手段や、ID、パスワード、電子署名等の認証機能手段が考えられる。

【0102】

暗号化手段を使用する場合は、通信端末のアプリケーションソフトと情報処理装置で同じ暗号化・復号化手段を持つ。また認証機能を使用する場合は、通信端末ユーザはデータベースにID、パスワード、電子署名等を登録しておき、情報処理装置はそれらの認証情報が一致していることが確認できたら通信端末ユーザからの情報を受信する。

【0103】

また通信端末ユーザは、情報処理装置から送信される認証情報と、予め情報処理装置から入手しておいた認証情報が一致していることが確認できたら、情報処理装置からの情報を受信する。

【0104】

本発明では、通信端末ユーザが設定する任意の使用料金設定を超えた、又は下回っている時に、通信端末ユーザにその旨を通知する機能を持つ。

【0105】

通信端末ユーザは、任意の使用料金と、その設定した使用料金を超えた、又は下回っている時に通知するようデータベースに設定する。情報処理装置はそれらの設定を認識し、通信端末ユーザから送信されてくる通信履歴情報から使用料金を算出し、データベースに設定されている使用料金を超えた、又は下回っている時に、通信端末ユーザに設定金額をいくら上回った、または下回っているかを通知する。

【0106】

本発明では、通信端末ユーザが契約している料金プランにおいて、無料通信料金が設定されている場合、通信端末ユーザに無料通信料金の残高、残り時間、残りパケットを通知する機能を持つ。

【0107】

通信端末ユーザは、データベースに無料通信料金の残高、残り時間、残りパケット数を通知させる時間、ベアラ毎の残高、残り時間、残りパケット数の割合等の内容を設定する。

【0108】

情報処理装置はそれらの設定を認識し、通信端末ユーザから送信されてくる通信履歴情報から使用料金を算出し、通信端末ユーザに、残高、残り時間、残りパケット数を通知する。

【0109】

通信端末ユーザは本発明が提供する、使用料金算出、シミュレーション、品質情報のうち、任意のサービスを選択することができる。

【0110】

通信端末ユーザは、シミュレーション内容、無料通信料金の算出、比較プラン数等デー

データベースに希望するサービスの種類、シミュレーション回数、品質情報等を受け取る回数、タイミングを設定する。

【0111】

情報処理装置はそれらの設定を認識し、通信端末ユーザから送信してくる通信履歴情報から使用料金、品質情報を算出し、通信端末ユーザの設定した日時に通信端末ユーザが要求した情報を送信する。

【0112】

本発明では、通信端末ユーザの加入者情報は公知のアプリケーションソフトやサービス提供者が作成するホームページを利用することでデータベースに登録、修正することができる。

【0113】

通信端末ユーザは、アプリケーションソフトを使用する場合は、アプリケーションソフトが提供するフォーマットに設定項目を入力し、データベースに送信する。ホームページを使用する場合は、通信端末ユーザが本サービス提供者が提供する加入者情報のホームページにアクセスし、必要事項を記入することで、データベースに通信端末ユーザの加入者情報を登録することができる。修正も同様の手段で可能である。

【0114】

本発明を使用すれば、通信端末ユーザは料金とサービス品質の両面から最適な料金プラン、通信事業者を選択することができる。また通信事業者は各ユーザの使用状況を詳細に把握することができ、適切な料金プランを検討する際に有効なデータや、サービスエリア拡充時に参考になる情報を得ることができる。

【図面の簡単な説明】

【0115】

【図1】本発明の一実施例構成図である。

【図2】本発明の品質統計情報説明図である。

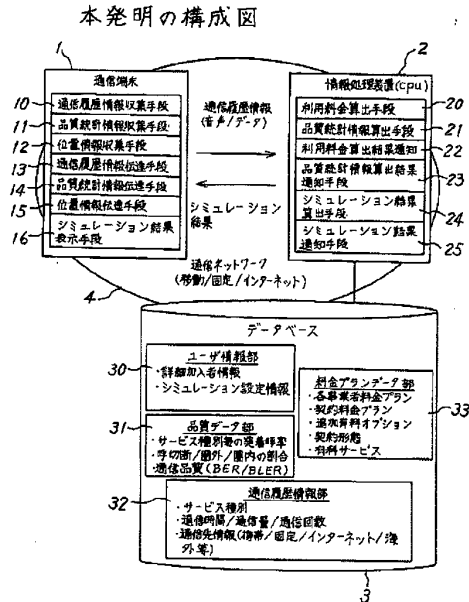
【図3】本発明の時間毎の品質統計情報説明図である。

【符号の説明】

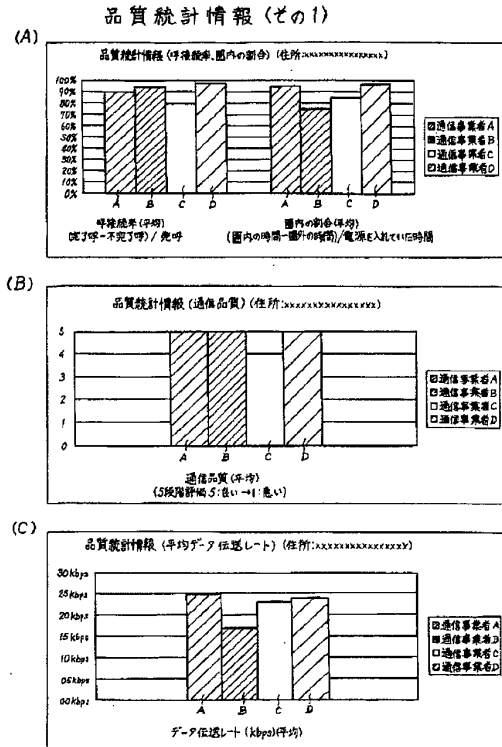
【0116】

- 1 通信端末
- 2 情報処理装置
- 3 データベース
- 4 通信ネットワーク

【図1】

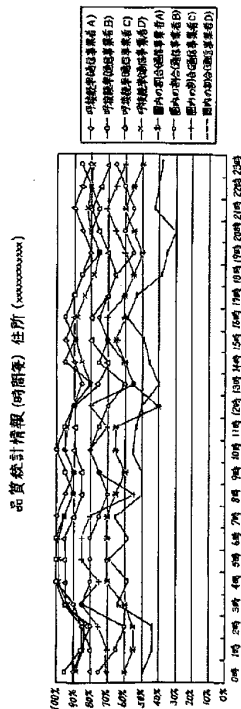


【図2】



【図3】

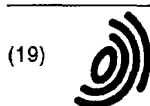
品質統計情報 (その2)



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(54) Method of verifying downloaded software and corresponding device

(57) The present invention relates to ensuring security for software downloads to a device, in which a smart card is used for storage of secure keys and for calculations using the secure keys. The result of the calculations using the smart card are passed to the device for comparison with calculations performed by the device on the downloaded software, to verify the downloaded software. Thus the security of the keys and calculations involving the secure keys are kept secure. Preferably root security keys stored in the smart card can be updated using communication system messaging protocols.

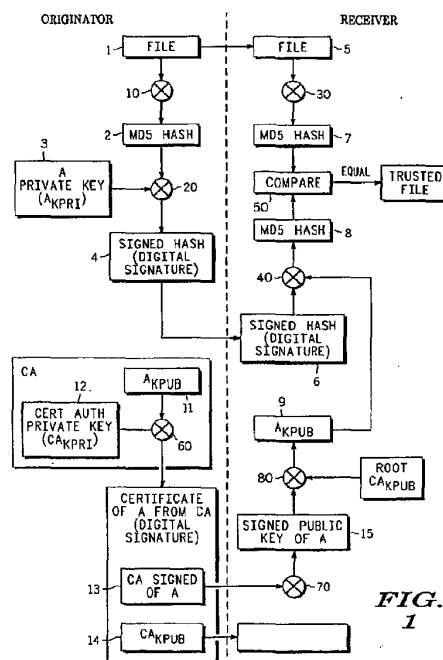


FIG. 1

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BNSDOCID: <EP 1289326A1_I_>

Description

[0001] The present invention relates to a method of verifying software downloaded from an originator to a device, and to a corresponding device. In particular, the invention relates to download verification in standardised execution environments such as the Mobile Execution Environment (MExE) and Java.

[0002] Increasingly it is becoming desirable for software to be downloaded to a portable device over the air. This allows the device to be upgraded with newly released software or enables new applications to be added to the device as these become available.

[0003] It is desirable that the device checks the authenticity of the downloaded software to determine whether, for example, the downloaded software has indeed been received from a trusted sender. In addition, it is desirable that the downloaded software should be restricted to a given domain, to avoid permission violation for the rest of the device.

[0004] This security can be ensured by keys, which are stored securely in the device such that they cannot be read or tampered with by applications except the security-checking environment. In addition it is desirable to update the keys periodically, and this must be done using a secure method.

[0005] Previously, it has been suggested to implement the security algorithms in software/hardware and then to protect them by hardware control on the processor of the terminal with memory management unit. However, this results in increased cost. In addition, the development of separate security hardware is undesirable.

[0006] The Mobile Execution Environment (MExE), which enables software download, is currently under standardisation. Three class marks are defined in the MExE environment. Class mark 1 relates to devices utilizing the Wireless Application Protocol (WAP); class mark 2 relates to devices, such as personal digital assistants (pda) or laptops using standard edition JAVA™ (J2SE); and class mark 3 relates to small devices, such as mobile telephones, using micro-edition JAVA™ (J2ME).

[0007] J2ME is being proposed as an environment for class mark 3 devices in MExE because of its small size, which makes it suitable for environments, such as the mobile communication environment for example, in which the available memory or processing power is limited and the size of files must be limited.

[0008] However, the security model for J2ME requires server-based pre-verification, in which a server inserts basic run-time security information in the software prior to download. The receiving device can then use the run-time security information to check the security of the download and verify the sender.

[0009] It is desirable to increase the security provided for software download, particularly in a MExE class mark 3 environment, so that server-based verification is avoided and software can be downloaded from a greater

variety of sources.

[0010] According to a first aspect of the present invention, there is provided a method of verifying software downloaded from an originator to a device adapted to receive, in use, a smart card having at least one secure key stored therein, comprising: receiving software and security information relating to the received software; obtaining in the smart card a first calculation result from the security information using at least one secure key; obtaining in the device a second calculation result from calculations performed on the received software; and comparing in the device first and second calculation results to verify the received software.

[0011] According to a second aspect of the invention, there is provided a device comprising: communication means for receiving software and security information relating to the received software; smart card interface means for passing the security information to a smart card coupled to the smart card interface means and for receiving from the smart card a first calculation result obtained from the security information by the smart card using at least one security key; means for obtaining a second calculation result from calculations performed on the received software; means for comparing first and second calculation results to verify the received software.

[0012] For a better understanding of the present invention, and to show how it may be brought into effect reference will now be made, by way of example to the accompanying drawings in which:

Figure 1 illustrates a known file transfer verification procedure;

Figure 2 shows a communication device;

Figure 3 illustrates a download verification procedure in accordance with the invention;

Figure 4 illustrates message creation for transfer of the root key in accordance with the invention;

Figure 5 illustrates update of the root key in accordance with the invention

[0013] The present invention is described with reference to the use of RSA cryptography. The RSA cryptography algorithm and principle are well known and therefore will not be explained in detail in this document. As will be apparent to a skilled person, other cryptography techniques may also be used in accordance with the invention.

[0014] Figure 1 illustrates a known file transfer verification procedure, for verifying the authenticity of a file transferred from an originator to a receiver. The principle behind this procedure is that in addition to the transfer of the file 1 a second piece of information which is related to both the file 1 and the originator is also transferred between the originator and the receiver, which information enables the receiver to confirm that the file comes from the originator. In addition, the receiver possesses or is passed a third piece of information, which enables

the receiver to confirm that the originator can be trusted and that it is therefore safe to execute the downloaded file.

[0015] In the illustrated procedure the originator generates the second piece of information by performing an MD5 hash operation 10 on the file 1 to be transferred to create an MD5 hash result 2. The MD5 hash operation is well known and will not be explained further. The MD5 hash result 2 is uniquely dependent on the file 1 and can be used to verify file 1.

[0016] Next the originator performs an RSA algorithm operation 20 on the MD5 hash result 2 using the private key of the originator (A_{KPR}) 3 to generate a signed hash (or digital signature) 4. The signed hash 4 thus depends upon the file and is signed as having been originated by A and can therefore act as the second piece of information mentioned above. The file 1 and the signed hash 4 are transferred to the receiver resulting in a received file 5 and a received signed hash 6.

[0017] In order to verify the received file, the receiver independently generates two versions of the MD5 hash result. The first MD5 hash result 7 is generated from the received file 5 using a MD5 hash operation 30, and the second MD5 hash result 8 is obtained from the received signed hash 6 by performing an RSA operation 40 on the received signed hash 6 using the public key of the originator A (A_{Kpub}) 9 held by the receiver. The first MD5 hash result 7 and the second MD5 hash result 8 are compared in a comparison operation 50 and if they are found to be equal, the received file 5 is authenticated and can be executed.

[0018] In order for the above authentication scheme to work, the receiver must have authenticated access to the public key of the originator A (A_{Kpub}). This is achieved in the illustrated procedure through the use of a certification authority. The certification authority is trusted by the receiver, such that received information signed by the certification authority is trusted by the receiver.

[0019] Therefore, as shown the certification authority performs an RSA algorithm operation 60 on the public key of the originator (A_{Kpub}) 11 using the private key of the certification authority (CA_{KPR}) 12 resulting in a signed key 13 of the originator A. The signed key 13 and the certification authority public key (CA_{Kpub}) 14 are transferred to the receiver. As shown, if necessary the signed key 13 undergoes a certificate chain analysis operation 70 to obtain the received signed public key 15 of the originator A.

[0020] A certificate chain analysis operation is required if the certification authority CA is not known by the receiver. In this case, the certification authority is requested to provide its public key signed by a further certificate authority using the private key of the further certificate authority. If the further certificate authority is trusted by the receiver, the receiver will be able to use the public key of the further signature authority to verify that the public key of the signed authority has been signed by

the private key of the further signature authority. The receiver can then trust the certificate authority and can use the received certificate authority public key. If the further certificate authority is not trusted by the receiver, use must be made of an additional certificate authority.

[0021] The receiver has stored therein a root certification authority public key. The root certification authority is the most trusted by the receiver, and ultimately the stored public key of the root certification authority can be used to verify all other certification authorities in a certificate chain situation.

[0022] The receiver then performs an RSA operation 80 on the resulting signed public key of the originator (A_{Kpub}) (15) using the root certification authority public key (Root CA_{Kpub}) to obtain the public key of the originator (A_{Kpub}) 9. The public key of the originator (A_{Kpub}) 9 is then used in the RSA operation 40 as described above.

[0023] The present invention is described below with reference to a communication device, such as a mobile telephone. However, it will be clear to a skilled person that the present invention is also applicable to other devices. An exemplary communication device 200 is now described with reference to Figure 2.

[0024] The communication device 200 shown in Figure 2 comprises a communication interface 210 coupled to an antenna 220 and to a processor 230. The processor 230 and the communication interface 210 are also coupled to volatile memory 240 and to a non-volatile memory 250. A smart card 260 is coupled to a smart card interface 270, which is also coupled to the processor 230. The smart card is equipped with its own processor 280 and memory 290.

[0025] The communication interface 210 comprises the necessary components to convert radio frequency signals for the communication device 200 received by the antenna 220 to digital signals to be stored in volatile memory 240 and/or non-volatile memory 250 and/or to be processed by processor 230, and to convert digital signals from the memories 240 and 250 and/or the processor 230 to radio frequency signals to be transmitted by the antenna 220. Thus communication interface 210 comprises radio frequency transmitter and receiver means and signal processor means, for example.

[0026] The volatile memory 240 and non-volatile memory 250 are used for storing program and other data for operation of the communication device 200.

[0027] The smart card is preferably a subscriber smart card (SIM) holding subscriber information used by the communication device 200, for example a Subscriber Identity Module card as currently used in the Global System for Mobile Communications (GSM system) and in use or proposed for other communication systems. However, it is possible that the smart card 260 may be another type of smart card received in the communication device instead of, or preferably in addition to a SIM card, for example an electronic commerce smart card.

[0028] As indicated above, the smart card is equipped with its own processor 280 and memory 290, and is capable of storing information therein and is also capable of carrying out operations or calculations on data received from the processor 230 via smart card interface 270 and of providing data or the results of such calculation to the processor 230 via smart card interface 270.

[0029] The smart card is preferably removably receivable in the communication device, for example by means of the provision of a slot in the housing of the communication device 200.

[0030] It will be appreciated by a skilled person that other components or arrangements of components within the communication device 200 are possible within the scope of the invention.

[0031] The secure download procedure in accordance with the invention will now be described with reference to Figure 3. In Figure 3 operations or data corresponding to operations or data in Figure 1 have been given similar reference numerals.

[0032] Figure 3 illustrates the download of an executable J2ME file in a MExE environment from an originator A to a device such as the communication device 200 described above with reference to Figure 2. As shown in Figure 3, box 3260 represents operations carried out and data stored in the smart card 260 of the communication device 200 shown in Figure 2, and the remaining operation and data storage is carried out in the rest of the communication device 200 shown in Figure 2.

[0033] As illustrated in Figure 2, the smart card 260 has no direct communications capability. Instead, the relevant data received by the communication device is passed by the processor 230 to the smart card 260 for storage therein and operation thereon.

[0034] In the procedure illustrated in Figure 3, the originator A performs an MD5 hash operation 310 on a file 31 to be transferred to create an MD5 hash result 32. As explained above, the MD5 hash result 32 is uniquely dependent on the file 31 and can be used to verify file 31.

[0035] Next the originator A performs an RSA algorithm operation 320 on the MD5 hash result 32 using the private key of the originator (A_{KPR}) 33 to generate a signed hash 34. The signed hash 34 thus depends upon the file and is signed as having been originated by A and can therefore act as the second piece of information mentioned above. The file 31 and the signed hash 34 are then sent to the communication device 200 resulting in a received file 35 and a received signed hash 36. File 35 is received using antenna 220 and communication interface 210 and is stored by the processor 230 in the volatile memory 240. In contrast, the signed hash 34 is received using antenna 220 and communication interface 210 and is sent by the processor 230 to the smart card 260 via smart card interface 270 and is stored in the smart card memory 290.

[0036] As described above, in order to verify the received file, two versions of the MD5 hash result must be

independently generated and compared. The first MD5 hash result 37 is generated by the communication device processor 230 from the received file 35 using a MD5 hash operation 330.

[0037] The second MD5 hash result 38 is obtained by the smart card from the received signed hash 36. The smart card processor 280 performs an RSA operation 340 on the received signed hash 36 stored in the smart card memory 390 using the public key of the originator A (A_{Kpub}) 39 stored in the smart card memory 290, as will be explained later.

[0038] The second MD5 hash result 38 is passed by the smart card processor 280 to the communication device processor 230 and the communication device processor 230 compares the first MD5 hash result 37 and the second MD5 hash result 38, calculated in the smart card 260, in a comparison operation 350. If the first MD5 hash result 37 and the second MD5 hash result 38 are found to be equal, the received file 35 is authenticated and can be executed.

[0039] In this arrangement, the smart card 260 must have authenticated access to the public key of the originator A (A_{Kpub}). This is achieved in the illustrated procedure according to Figure 3 through the use of the root certification authority public key stored in the smart card memory 290. The root certification authority is trusted by the communications device, such that received information signed by the certification authority is trusted.

[0040] In this context, there may be more than one root certification authority. For example in the context of a mobile telephone the manufacturer and/or the operator can act as a root authority. In addition, it is possible to specify one or more trusted third parties as root certification authorities. The public key for each of the root certification authorities (eg the operator public root key (OPRK); the manufacturer public root key (MPRK); and third party public root key (TPRK)) is stored in the smart card of the communication device 200, for example during provisioning of a mobile telephone SIM card.

[0041] In order that the smart card 260 has authenticated access to the public key of the originator A (A_{Kpub}), as shown the root certification authority performs an RSA algorithm operation 360 on the public key of the originator (A_{KPR}) 311 using the private key of the certification authority ($RootCA_{KPR}$) 312 resulting in a certificate from A 321 signed by the root certification authority. This certificate 321 is sent to the communications device 200, is received using antenna 220 and communication interface 210 and is sent by the processor 230 to the smart card 260 via smart card interface 270 and is stored in the smart card memory 290 as certificate 322.

[0042] The Root certification authority public key ($RootCA_{Kpub}$) 332 is already stored in the smart card memory 290, as indicated above. The smart card processor can perform an RSA operation 380 on the received certificate 322 using the Root Certification Authority public key ($RootCA_{Kpub}$) 332 to obtain the public

key of the originator A ($A_{K_{pub}}$) 39. The smart card processor can then use the obtained public key of the originator A ($A_{K_{pub}}$) 39 and the received signed hash 36 in RSA operation 340 to obtain the smart card MD5 hash value 38, as outlined above.

[0043] Also shown in Figure 3 is the transfer of the Root Certification Authority public key ($RootCA_{K_{pub}}$) 331 to the communications device for storage in the smart card memory as Root Certification Authority public key ($RootCA_{K_{pub}}$) 332. It is desirable to update the root certification authority keys periodically in a secure manner otherwise the security of the system will be compromised.

[0044] A preferred mechanism for the secure transfer of a Root public key (for example OPRK, MPRK, TPRK) using communication system messaging technology will now be explained with reference to Figures 4 and 5.

[0045] Figure 4 illustrates message creation for transfer of a root key, for example the operator public root key (OPRK), to the smart card 360 in accordance with the invention. In this exemplary arrangement, the update is achieved using a SMS message as provided in the GSM/UMTS systems, although other messaging techniques could be used.

[0046] An RSA operation is performed on the new OPRK 41 with the operator's private root key 42 corresponding to the old OPRK stored in the smart card 360. As mentioned earlier, the old OPRK may have been stored in the smart card 360 during provisioning, or during a previous update of the root key. The resulting signed new operator public root key 44 is included in an SMS message 45 to be sent to the communication device. The SMS message 45 has an SMS header portion 451 and SMS download command 452 in addition to the signed new operator public root key 44. The SMS message is encrypted by the communication system prior to being sent to the communication device.

[0047] Figure 5 illustrates update of the root key in the communication device in accordance with an embodiment of the invention. In this exemplary embodiment of the invention, the SMS message 45 sent by the network 500 to the communication device 200 is passed to the smart card 260. Once the encrypted SMS message 45 is received in the smart card 260, the smart card 260 undertakes an SMS message analysis and memory update procedure 51.

[0048] In the SMS message analysis and memory update procedure 51 the SMS message is initially decrypted and the SMS message is analysed. The download command 452 instructs the smart card 260 that a new OPRK is being sent to the smart card 260. The smart card 260 performs an RSA operation on the received signed new OPRK using the old OPRK already stored in the smart card 260 to verify the identity of the sender. The OPRK stored in the smart card can then be updated using the new value. Preferably a confirmation message 52 is sent from the smart card 260 to the network using the communication interface 210 of the communication

device 200.

[0049] Although the update of the operator public root key (OPRK) has been described above, it would be possible to update any root key stored in the smart card in the same way.

[0050] In accordance with an alternative embodiment of the invention, the manufacturer root public key may be stored partially in the smart card memory and partially in the communications device memory. This arrangement is more secure since the communication device then contributes to ensuring the security of download in the manufacturer domain using the manufacturer root public key. This helps to prevent an insecure smart card from changing the manufacturer public root key via download authorization.

[0051] Thus the present invention proposes a solution to ensuring security for software downloads to a device, in which a smart card is used for storage of secure keys and for calculations using the secure keys. The result of the calculations using the smart card are passed to the device for comparison with calculations performed by the device on the downloaded software, to verify the downloaded software.

[0052] Since the secure keys are stored on the smart card and calculations involving the secure keys are performed by the smart card, the security of the secure keys can be ensured. In addition, the result of the calculation performed on the received file by the device is not passed to the smart card.

[0053] As will be apparent to a skilled person, the invention could be implemented in a different form from that shown herein, and so the invention is intended to encompass all arrangements and variations within the scope of the appended claims.

Claims

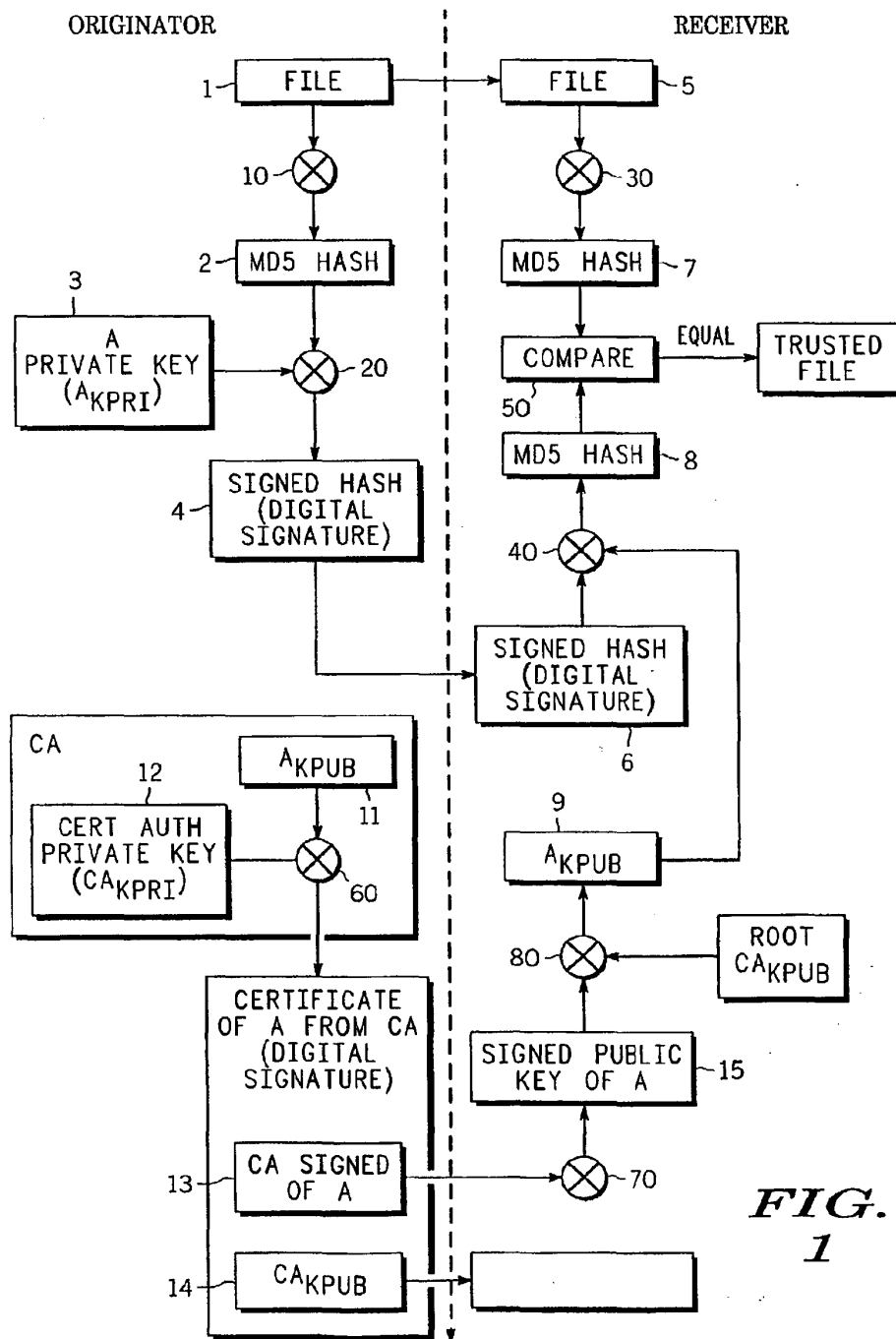
1. A method of verifying software downloaded from an originator to a device adapted to receive, in use, a smart card having at least one secure key stored therein, comprising:

receiving software and security information relating to the received software;
obtaining in the smart card a first calculation result from the security information using at least one secure key;
obtaining in the device a second calculation result from calculations performed on the received software; and
comparing in the device first and second calculation results to verify the received software.

2. The method as claimed in claim 1, further comprising the steps of;

receiving additional signed originator key infor-

- mation;
obtaining, in the smart card, originator key information from the received signed originator key information using a root security key stored therein; and
obtaining in the smart card the first calculation result from the security information using the originator key information.
3. The method as claimed in claim 2 wherein the root security key stored in the smart card is updated by receiving a root security key update message containing a new root security key;
verifying the new root security key using the existing root security key stored in the smart card;
storing the new root security key in the smart card.
4. The method as claimed in claim 2 or 3, wherein part of the root security key is stored in the smart card and part of the root security key is stored in the device.
5. The method as claimed in any preceding claim, wherein the smart card is a Subscriber Identity Module (SIM) card
6. A device comprising
communication means for receiving software and security information relating to the received software;
smart card interface means for passing the security information to a smart card coupled to the smart card interface means and for receiving from the smart card a first calculation result obtained from the security information by the smart card using at least one security key;
means for obtaining a second calculation result from calculations performed on the received software;
means for comparing first and second calculation results to verify the received software.
7. The device as claimed in claim 6 wherein
the communications means also receives additional signed originator key information; and
the smart card interface also passes the additional signed originator key information to the smart card, which obtains originator key information from the received signed originator key information using a root security key stored therein; and obtains the first calculation result from the security information using the originator key information.
8. The device as claimed in claim 7 wherein
the communications means also receives a root security key update message containing a new root security key; and
- the smart card interface passes the root security key update message to the smart card, which verifies the new root security key using the existing root security key stored in the smart card; and stores the new root security key in the smart card.
9. The device as claimed in claim 7 or 8, wherein the device comprises storage means and part of the root security key is stored in the smart card and part of the root security key is stored in the storage means.
10. The device as claimed in one of claims 6-9, wherein the smart card is a Subscriber Identity Module (SIM) card.



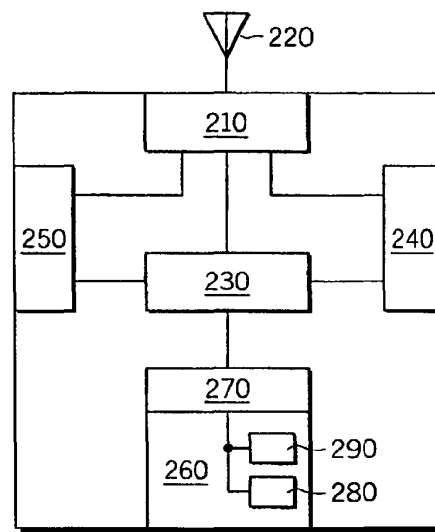


FIG. 2 200

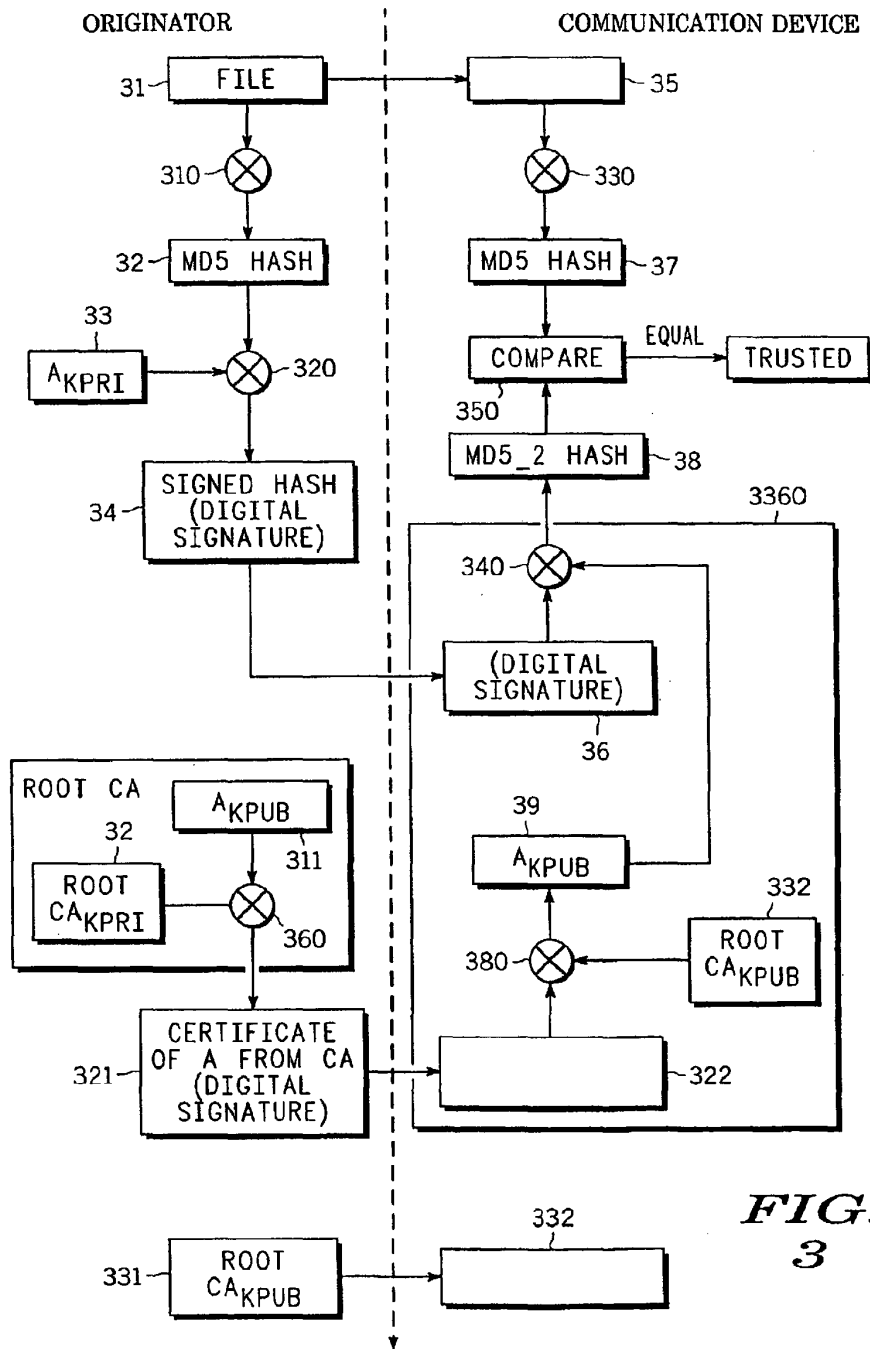


FIG. 3

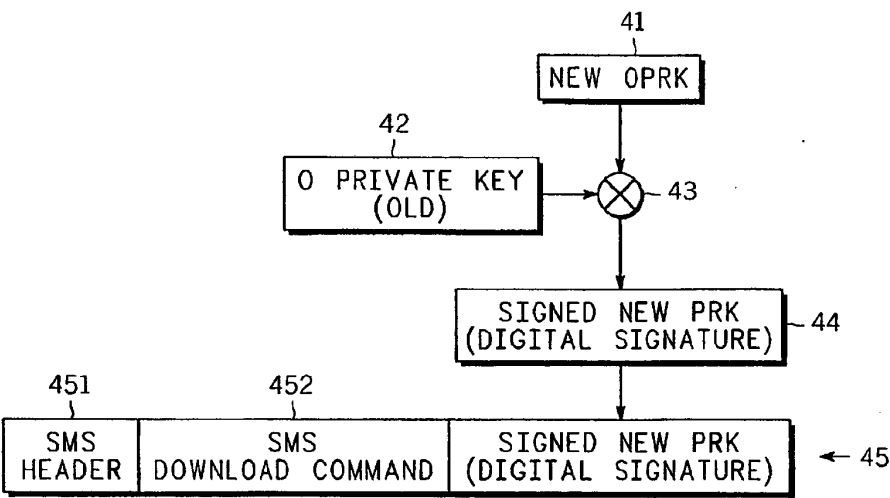
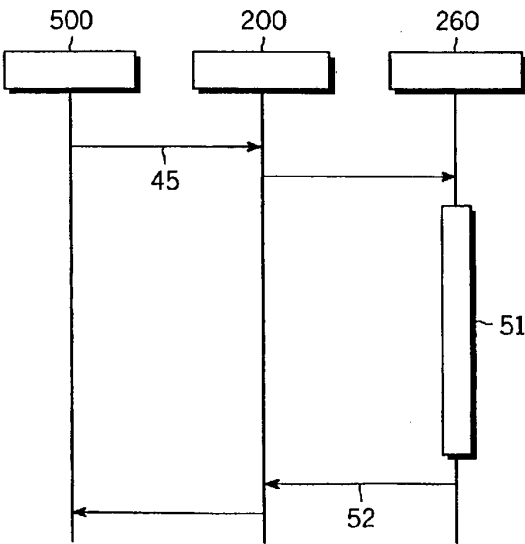


FIG. 4

FIG. 5



EP 1 289 326 A1



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 01 40 2259

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 6 124 799 A (PARKER JOHN PATRICK) 26 September 2000 (2000-09-26) * the whole document *	1-4, 6-9	H04Q7/32
X	EP 0 562 890 A (HUTCHISON MICROTEL LIMITED) 29 September 1993 (1993-09-29) * column 4, line 30 - column 5, line 32 *	1, 6	
A	EP 1 124 401 A (LUCENT TECHNOLOGIES INC) 16 August 2001 (2001-08-16) * paragraphs '0002!'-'0019!' * * abstract; claims 1-13 *	2-4, 7-9	
A	EP 0 977 452 A (LUCENT TECHNOLOGIES INC) 2 February 2000 (2000-02-02) * the whole document *	2-4, 7-9	
A	EP 0 463 384 A (CIT ALCATEL) 2 January 1992 (1992-01-02) * the whole document *	1, 6	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			H04Q
Place of search THE HAGUE		Date of completion of the search 22 February 2002	Examiner Coppieters, S
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background D : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after, the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>			

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 01 40 2259

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

22-02-2002

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6124799 A	26-09-2000	US 5864757 A	26-01-1999
		AU 715488 B2	03-02-2000
		AU 1409997 A	03-07-1997
		CA 2239550 A1	19-06-1997
		EP 0867099 A2	30-09-1998
		JP 11501182 T	26-01-1999
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EP 0562890 A	29-09-1993	AT 193965 T	15-06-2000
		DE 69328847 D1	20-07-2000
		DE 69328847 T2	07-12-2000
		EP 0562890 A1	29-09-1993
		ES 2149801 T3	16-11-2000
EP 1124401 A	16-08-2001	AU 1828001 A	16-08-2001
		BR 0100191 A	09-10-2001
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		EP 1124401 A2	16-08-2001
		JP 2001251292 A	14-09-2001
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EP 0463384 A	02-01-1992	FR 2662878 A1	06-12-1991
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		DE 69117814 D1	18-04-1996
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		ES 2084726 T3	16-05-1996
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		JP 4233341 A	21-08-1992
		NO 178597 B	15-01-1996
		US 5303285 A	12-04-1994

EPO FORM P438

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

Electronic Patent Application Fee Transmittal				
Application Number:		15369542		
Filing Date:		05-Dec-2016		
Title of Invention:		System and Method for Wireless Network Offloading		
First Named Inventor/Applicant Name:		Gregory G. Raleigh		
Filer:		James E. Harris/Ann Taylor		
Attorney Docket Number:		RALEP049D1C1		
Filed as Small Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
UTILITY FILING FEE (ELECTRONIC FILING)	4011	1	70	70
UTILITY SEARCH FEE	2111	1	300	300
UTILITY EXAMINATION FEE	2311	1	360	360
Pages:				
Claims:				
Miscellaneous-Filing:				
PUBL. FEE- EARLY, VOLUNTARY, OR NORMAL	1504	1	0	0
LATE FILING FEE FOR OATH OR DECLARATION	2051	1	70	70

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Extension - 1 month with \$0 paid	2251	1	100	100
Miscellaneous:				
Total in USD (\$)				900

Electronic Acknowledgement Receipt	
EFS ID:	28641601
Application Number:	15369542
International Application Number:	
Confirmation Number:	6887
Title of Invention:	System and Method for Wireless Network Offloading
First Named Inventor/Applicant Name:	Gregory G. Raleigh
Customer Number:	106963
Filer:	James E. Harris/Ann Taylor
Filer Authorized By:	James E. Harris
Attorney Docket Number:	RALEP049D1C1
Receipt Date:	15-MAR-2017
Filing Date:	05-DEC-2016
Time Stamp:	18:08:35
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	\$ 900
RAM confirmation Number	031617INTEFSW00005052505876
Deposit Account	505876
Authorized User	Ann Taylor
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.16 (National application filing, search, and examination fees) 37 CFR 1.17 (Patent application and reexamination processing fees)	

37 CFR 1.19 (Document supply fees)					
37 CFR 1.20 (Post Issuance fees)					
37 CFR 1.21 (Miscellaneous fees and charges)					
File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Extension of Time	P049D1C1_Ext.pdf	163902	no	2
			a68c74181df1d1238c405f2a7a22b5cf47a9095f		
Warnings:					
Information:					
2	Assignee showing of ownership per 37 CFR 3.73	P049D1C1_373Stmt.pdf	120984	no	3
			5a68e3483a7106f7b24b5a6cf73810761bc1121e		
Warnings:					
Information:					
3		P049D1C1_NFMResponse.pdf	153463	yes	6
			1dee8f0438fe28c8d43dd1b6a32be87cc199def8		
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Applicant Response to Pre-Exam Formalities Notice		1	1	
	Preliminary Amendment		2	3	
	Applicant Response to Pre-Exam Formalities Notice		4	6	
Warnings:					
Information:					
4	Transmittal Letter	P049D1C1_IDSTransLtr.pdf	59975	no	2
			ff3945ac3eb82b6df49c06b244777688c720ea14		
Warnings:					
Information:					
5	Information Disclosure Statement (IDS) Form (SB08)	P049D1C1_IDS1.pdf	622988	no	37
			722e7e1ac0ba15ea74a67cddb97f12887436f8ec		

Warnings:					
Information:					
6	Information Disclosure Statement (IDS) Form (SB08)	P049D1C1_IDS2.pdf	621340	no	33
			0370e29fe27d67bf5ee8467bdd07c47e37cf150		
Warnings:					
Information:					
7	Information Disclosure Statement (IDS) Form (SB08)	P049D1C1_IDS3.pdf	621519	no	33
			ce3df3f2b0642d4345a565b341cb8339699615e9		
Warnings:					
Information:					
8	Information Disclosure Statement (IDS) Form (SB08)	P049D1C1_IDS4.pdf	618993	no	31
			86d930a604a67dbcb519789c82b8863a87b38366		
Warnings:					
Information:					
9	Information Disclosure Statement (IDS) Form (SB08)	P049D1C1_IDS5.pdf	617587	no	21
			3212abdbfa49d1514487917b31f40782176ce0ce		
Warnings:					
Information:					
10	Foreign Reference	2091.pdf	4030163	no	16
			9f5a695d3972f432ff9791f8b2ac99ef7cbca74d		
Warnings:					
Information:					
11	Foreign Reference	2092.pdf	2382529	no	12
			5c57dc228fa91cd9301830aad5e4493f4c99b261		
Warnings:					
Information:					
12	Fee Worksheet (SB06)	fee-info.pdf	40637	no	2
			6d3ad9133f5446909ab7003d444bd9b9db6afc2a		
Warnings:					
Information:					

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)		Docket Number (Optional) RALEP049D1C1																																		
Application Number 15/369,542	Filed December 5, 2016																																			
For System and Method for Wireless Network Offloading																																				
Art Unit	Examiner not yet assigned																																			
<p>This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above-identified application.</p> <p>The requested extension and fee are as follows (check time period desired and enter the appropriate fee below):</p> <table style="width: 100%; border-collapse: collapse;"><thead><tr><th></th><th style="text-align: center;"><u>Fee</u></th><th style="text-align: center;"><u>Small Entity Fee</u></th><th style="text-align: center;"><u>Micro Entity Fee</u></th><th></th></tr></thead><tbody><tr><td>☒ One month (37 CFR 1.17(a)(1))</td><td style="text-align: center;">\$200</td><td style="text-align: center;">\$100</td><td style="text-align: center;">\$50</td><td>\$ <u>100</u></td></tr><tr><td>☐ Two months (37 CFR 1.17(a)(2))</td><td style="text-align: center;">\$600</td><td style="text-align: center;">\$300</td><td style="text-align: center;">\$150</td><td>\$ _____</td></tr><tr><td>☐ Three months (37 CFR 1.17(a)(3))</td><td style="text-align: center;">\$1,400</td><td style="text-align: center;">\$700</td><td style="text-align: center;">\$350</td><td>\$ _____</td></tr><tr><td>☐ Four months (37 CFR 1.17(a)(4))</td><td style="text-align: center;">\$2,200</td><td style="text-align: center;">\$1,100</td><td style="text-align: center;">\$550</td><td>\$ _____</td></tr><tr><td>☐ Five months (37 CFR 1.17(a)(5))</td><td style="text-align: center;">\$3,000</td><td style="text-align: center;">\$1,500</td><td style="text-align: center;">\$750</td><td>\$ _____</td></tr></tbody></table> <p>☒ Applicant asserts small entity status. See 37 CFR 1.27.</p> <p>☐ Applicant certifies micro entity status. See 37 CFR 1.29. Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously.</p> <p>☐ A check in the amount of the fee is enclosed.</p> <p>☐ Payment by credit card. Form PTO-2038 is attached.</p> <p>☐ The Director has already been authorized to charge fees in this application to a Deposit Account.</p> <p>☒ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number <u>505876</u>.</p> <p>☒ Payment made via EFS-Web.</p> <p>WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.</p> <p>I am the</p> <p>☐ applicant.</p> <p>☒ attorney or agent of record. Registration number <u>40013</u>.</p> <p>☐ attorney or agent acting under 37 CFR 1.34. Registration number _____.</p> <table style="width: 100%; border-collapse: collapse;"><tr><td style="width: 50%; padding: 5px;"><u>/James E. Harris/</u> Signature</td><td style="width: 50%; padding: 5px;"><u>March 15, 2017</u> Date</td></tr><tr><td style="padding: 5px;"><u>James E. Harris</u> Typed or printed name</td><td style="padding: 5px;"><u>903-201-6212</u> Telephone Number</td></tr></table> <p>NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms if more than one signature is required, see below*.</p>				<u>Fee</u>	<u>Small Entity Fee</u>	<u>Micro Entity Fee</u>		☒ One month (37 CFR 1.17(a)(1))	\$200	\$100	\$50	\$ <u>100</u>	☐ Two months (37 CFR 1.17(a)(2))	\$600	\$300	\$150	\$ _____	☐ Three months (37 CFR 1.17(a)(3))	\$1,400	\$700	\$350	\$ _____	☐ Four months (37 CFR 1.17(a)(4))	\$2,200	\$1,100	\$550	\$ _____	☐ Five months (37 CFR 1.17(a)(5))	\$3,000	\$1,500	\$750	\$ _____	<u>/James E. Harris/</u> Signature	<u>March 15, 2017</u> Date	<u>James E. Harris</u> Typed or printed name	<u>903-201-6212</u> Telephone Number
	<u>Fee</u>	<u>Small Entity Fee</u>	<u>Micro Entity Fee</u>																																	
☒ One month (37 CFR 1.17(a)(1))	\$200	\$100	\$50	\$ <u>100</u>																																
☐ Two months (37 CFR 1.17(a)(2))	\$600	\$300	\$150	\$ _____																																
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☐ Four months (37 CFR 1.17(a)(4))	\$2,200	\$1,100	\$550	\$ _____																																
☐ Five months (37 CFR 1.17(a)(5))	\$3,000	\$1,500	\$750	\$ _____																																
<u>/James E. Harris/</u> Signature	<u>March 15, 2017</u> Date																																			
<u>James E. Harris</u> Typed or printed name	<u>903-201-6212</u> Telephone Number																																			

☐ * Total of _____ forms are submitted.

This collection of information is required by 37 CFR 1.136(a). The information is required to obtain or retain a benefit by the public, which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 6 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Mail Stop PCT, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: Headwater Research LLC

Application No./Patent No.: 15/369,542 Filed/Issue Date: 12/5/2016

Titled: System and Method for Wireless Network Offloading

Headwater Research LLC, a limited liability company

(Name of Assignee)

(Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☒ The assignee of the entire right, title, and interest.
2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):
- ☐ The extent (by percentage) of its ownership interest is ____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.
- ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (e.g., bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

- A. ☐ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.
- B. ☒ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: Inventors To: Headwater Partners I LLC

The document was recorded in the United States Patent and Trademark Office at
Reel 040524, Frame 0967, or for which a copy thereof is attached.

2. From: Headwater Partners I LLC To: Headwater Research LLC

The document was recorded in the United States Patent and Trademark Office at
Reel 041268, Frame 0108, or for which a copy thereof is attached.

[Page 1 of 2]

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

STATEMENT UNDER 37 CFR 3.73(c)

3. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

4. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☒ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/James E. Harris/

Signature

James E. Harris

Printed or Typed Name

March 15, 2017

Date

40013

Title or Registration Number

[Page 2 of 2]

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Raleigh et al.	Examiner: not yet assigned
Serial No.: 15/369,542	Art Unit:
Filed: December 5, 2016	Conf. No.: 6887
Title: System and Method for Wireless Network Offloading	

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

**RESPONSE TO NOTICE TO FILE MISSING PARTS AND PRELIMINARY
AMENDMENT**

In response to the Notice to File Missing Parts dated December 15, 2016 (the “Notice”), the no-fee deadline for response being February 16, 2017, please enter the following amendments and remarks:

Amendments to the Claims begin on page 2.

Remarks begin on page 4.



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY DOCKET NO	TOT CLAIMS	IND CLAIMS
15/369,542	12/05/2016	2642	800	RALEP049D1C1	10	1

CONFIRMATION NO. 6887

UPDATED FILING RECEIPT



106963
Headwater Research LLC
1011 Pruitt Place
Tyler, TX 75703

Date Mailed: 03/17/2017

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

Gregory G. Raleigh, Woodside, CA;
Alireza Raissinia, Monte Sereno, CA;
James Lavine, Corte Madera, CA;

Applicant(s)

Headwater Partners I LLC, Tyler, TX;

Power of Attorney: The patent practitioners associated with Customer Number 106963

Domestic Priority data as claimed by applicant

This application is a CON of 14/156,428 01/15/2014 PAT 9532261
which is a DIV of 13/134,005 05/25/2011 PAT 8635335
which is a CIP of 12/380,778 03/02/2009 PAT 8321526
and is a CIP of 12/380,780 03/02/2009 PAT 8839388
and claims benefit of 61/348,022 05/25/2010
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and claims benefit of 61/422,565 12/13/2010

page 1 of 4

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and claims benefit of 61/435,564 01/24/2011
and claims benefit of 61/472,606 04/06/2011
and said 12/380,778 03/02/2009
claims benefit of 61/206,354 01/28/2009
and claims benefit of 61/206,944 02/04/2009
and claims benefit of 61/207,393 02/10/2009
and claims benefit of 61/207,739 02/13/2009
and said 12/380,780 03/02/2009
claims benefit of 61/206,354 01/28/2009
and claims benefit of 61/206,944 02/04/2009
and claims benefit of 61/207,393 02/10/2009
and claims benefit of 61/207,739 02/13/2009

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see <http://www.uspto.gov> for more information.) - None.

Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 12/13/2016

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 15/369,542**

Projected Publication Date: 06/22/2017

Non-Publication Request: No

Early Publication Request: No

**** SMALL ENTITY ****

Title

System and Method for Wireless Network Offloading

Preliminary Class

455

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international

page 2 of 4

patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at <http://www.uspto.gov/web/offices/pac/doc/general/index.html>.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, <http://www.stopfakes.gov>. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and

page 3 of 4

Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign Assets Control, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

SelectUSA

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop technology, manufacture products, deliver services, and grow your business, visit <http://www.SelectUSA.gov> or call +1-202-482-6800.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875						Application or Docket Number 15/369,542				
APPLICATION AS FILED - PART I										
(Column 1)		(Column 2)		SMALL ENTITY		OR OTHER THAN SMALL ENTITY				
FOR	NUMBER FILED	NUMBER EXTRA	RATE(\$)	FEE(\$)		RATE(\$)	FEE(\$)			
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	70		N/A				
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A	300		N/A				
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	360		N/A				
TOTAL CLAIMS (37 CFR 1.16(i))	10	minus 20 = *	x 40 =	0.00	OR					
INDEPENDENT CLAIMS (37 CFR 1.16(h))	1	minus 3 = *	x 210 =	0.00						
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			0.00						
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0.00						
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	730		TOTAL				
APPLICATION AS AMENDED - PART II										
(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY		OR OTHER THAN SMALL ENTITY		
AMENDMENT A		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)
	Total (37 CFR 1.16(i))	*	Minus	**	=	x	=	OR	x	=
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x	=	OR	x	=
	Application Size Fee (37 CFR 1.16(s))							OR		
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	
AMENDMENT B		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)
	Total (37 CFR 1.16(i))	*	Minus	**	=	x	=	OR	x	=
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x	=	OR	x	=
	Application Size Fee (37 CFR 1.16(s))							OR		
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	
<div style="font-size: x-small;"> * If the entry in column 1 is less than the entry in column 2, write "0" in column 3. ** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20". *** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3". The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1. </div>										

POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:



Practitioners associated with Customer Number:

106963

OR



Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number

Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignments documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:



The address associated with Customer Number:

106963

OR

☐	Firm or Individual Name			
	Address			
	City	State	Zip	
	Country			
	Telephone	Email		

Assignee Name and Address: Headwater Research LLC
1011 Pruitt Place
Tyler, TX 75703 (USA)

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of The practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record	
The individual whose signature and title is supplied below is authorized to act on behalf of the assignee	
Signature	Date January 3, 2017
Name	Telephone 650-517-2782
Title	Chief Financial Officer

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt	
EFS ID:	28973391
Application Number:	15369542
International Application Number:	
Confirmation Number:	6887
Title of Invention:	System and Method for Wireless Network Offloading
First Named Inventor/Applicant Name:	Gregory G. Raleigh
Customer Number:	106963
Filer:	James E. Harris/Ann Taylor
Filer Authorized By:	James E. Harris
Attorney Docket Number:	RALEP049D1C1
Receipt Date:	19-APR-2017
Filing Date:	05-DEC-2016
Time Stamp:	18:35:08
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
------------------------	----

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	P049D1C1_SupplementalADS.pdf	67631 538468ec4dc569aa55fa5b81f9d237dc100b9148	no	1

Warnings:

Information:					
This is not an USPTO supplied ADS fillable form					
2	Power of Attorney	HWR_POA.pdf	1117158	no	2
			29f7900a48aab77c08ab016fed0337e3ae5a66d0		
Warnings:					
Information:					
			Total Files Size (in bytes):	1184789	
<p>This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.</p> <p><u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.</p> <p><u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.</p> <p><u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.</p>					

SUPPLEMENTAL Application Data Sheet		Atty Docket No.	RALEP049D1C1
		Application No.	15/369,542
Title of Invention	System and Method for Wireless Network Offloading		

Applicant Information:

Applicant 1 –

Applicant is the Assignee.

Applicant is an Organization.

Organization Name: ~~Headwater Partners I LLC~~ Headwater Research LLC
1011 Pruitt Place
Tyler, TX 75703 US
903-201-6212
patent@headwaterllc.com

Signature:

Signature: /James E. Harris/

Date: April 19, 2017

Printed/Typed Name: James E. Harris

Registration Number: 40,013



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY DOCKET NO	TOT CLAIMS	IND CLAIMS
15/369,542	12/05/2016	2464	800	RALEP049D1C1	10	1

106963
Headwater Research LLC
1011 Pruitt Place
Tyler, TX 75703

CONFIRMATION NO. 6887
REPLACEMENT FILING RECEIPT



000000090821332

Date Mailed: 04/25/2017

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

Gregory G. Raleigh, Woodside, CA;
Alireza Raissinia, Monte Sereno, CA;
James Lavine, Corte Madera, CA;

Applicant(s)

Headwater Research LLC, Tyler, TX;

Power of Attorney: The patent practitioners associated with Customer Number 106963

Domestic Priority data as claimed by applicant

This application is a CON of 14/156,428 01/15/2014 PAT 9532261
which is a DIV of 13/134,005 05/25/2011 PAT 8635335
which is a CIP of 12/380,778 03/02/2009 PAT 8321526
and is a CIP of 12/380,780 03/02/2009 PAT 8839388
and claims benefit of 61/348,022 05/25/2010
and claims benefit of 61/381,159 09/09/2010
and claims benefit of 61/381,162 09/09/2010
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and claims benefit of 61/389,547 10/04/2010
and claims benefit of 61/407,358 10/27/2010
and claims benefit of 61/418,507 12/01/2010
and claims benefit of 61/418,509 12/01/2010
and claims benefit of 61/420,727 12/07/2010
and claims benefit of 61/422,565 12/13/2010

page 1 of 4

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and claims benefit of 61/435,564 01/24/2011
and claims benefit of 61/472,606 04/06/2011
and said 12/380,778 03/02/2009
claims benefit of 61/206,354 01/28/2009
and claims benefit of 61/206,944 02/04/2009
and claims benefit of 61/207,393 02/10/2009
and claims benefit of 61/207,739 02/13/2009
and said 12/380,780 03/02/2009
claims benefit of 61/206,354 01/28/2009
and claims benefit of 61/206,944 02/04/2009
and claims benefit of 61/207,393 02/10/2009
and claims benefit of 61/207,739 02/13/2009

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see <http://www.uspto.gov> for more information.) - None.

Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 12/13/2016

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 15/369,542**

Projected Publication Date: 06/22/2017

Non-Publication Request: No

Early Publication Request: No

**** SMALL ENTITY ****

Title

System and Method for Wireless Network Offloading

Preliminary Class

370

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

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106963
Headwater Research LLC
1011 Pruitt Place
Tyler, TX 75703

CONFIRMATION NO. 6887
POA ACCEPTANCE LETTER



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Date Mailed: 04/25/2017

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 04/19/2017.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

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	Filing Date		2016-12-05
	First Named Inventor	Gregory G. Raleigh	
	Art Unit	2464	
	Examiner Name	Ngo, Ricky Quoc	
	Attorney Docket Number	RALEP049D1C1	

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	Attorney Docket Number	RALEP049D1C1	

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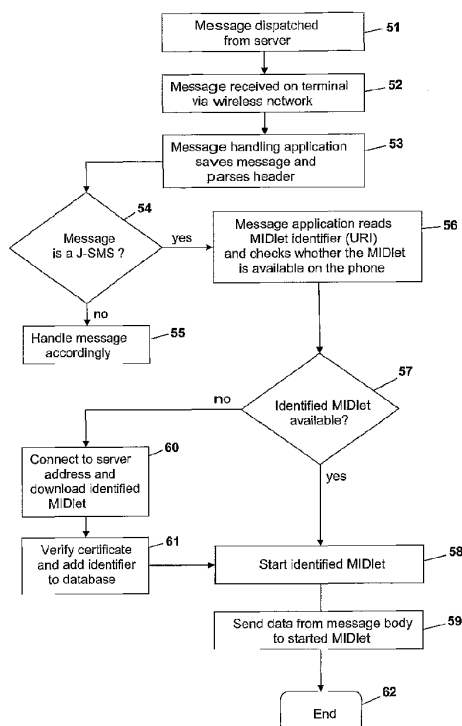
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[Continued on next page]

(54) Title: FLEXIBLE MESSAGING SYSTEM



(57) Abstract: A universal messaging system for wireless networks that can handle a great variety of different content. The messaging system operates with messages that include an application identifier in the header for an application in platform independent code. The message body contains data to be used by the identified application. The mobile terminals for operation on the wireless network are provided with native software and with a virtual machine capable of executing platform independent code. The identifier allows the mobile terminal to start the correct application for using the data contained in the message body. A uniform recourse identifier (URI) is used to identify the application and to provide an address at which the application can be downloaded if it is not yet available on the message receiving mobile terminal.

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FLEXIBLE MESSAGING SYSTEM

The present invention relates to the use of messaging for sending and receiving various items in a wireless communication network.

BACKGROUND ART

Smart Messaging is a concept developed by Nokia for sending and receiving ring tones, picture messages, operator logos, business cards, calendar requests, and Internet settings over the Short Message Service (SMS). Since its introduction in 1997, Smart Messaging has become an extremely popular terminal-specific content delivery technology and the de facto standard for the industry. Examples of different SMS type messages are: Business Card format, Calendar format, Ringing tone format, OTA Bitmap format, CLI Icon format, Operator logo format, Picture Message format and Downloadable Profile message format. There are advanced message types that allow e.g. a network operator to send a complex set of configuration information like "GPRS settings" to a mobile phone. The software on the phones presently on the market is programmed to handle, on average, about 6 to 8 of these different message types. The message types that a phone can handle is determined by the manufacturer, depending on the target customer group, since it is not realistic to attempt to provide a phone that can handle all available message types.

There is presently a fast increase in the number of applications for mobile phones, such as e.g. background images, screen savers, location based services, financial services, operator controlled updating or settings/phonebook contents, etc. that have created a need to increase in the number of message types. It is

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however problematical to harmonize these message types between the different phone manufacturers, despite the dominance of the Nokia Smart Messaging Concept. The present SMS standard may be augmented as described below
5 to provide for more flexible handling of increasing demand.

Accordingly, a need exists for a universal messaging system for wireless networks that can handle a great
10 variety of different content.

DISCLOSURE OF THE INVENTION

The devices and method described below provide for a
15 method of handling incoming messages received on a mobile communication terminal via a wireless network, the terminal having native software and a virtual machine capable of executing applications in platform independent object code. The method comprises the step of receiving
20 and storing a message that comprises a header and a message body. The header contains an identifier for an application in platform independent object code to be executed by the virtual machine. In the next step it is verified if the identified application is available on
25 the terminal, and the identified application is started when available on the terminal.

Thus, the terminal is able to automatically start the application required for using the data in the message
30 body of a received message, regardless of the type and version of the native software of the terminal unless the required application is not available on the terminal. Therefore, the header may further contain an address at which the identified application can be downloaded from a
35 server that is accessible through the wireless network, and the method further comprises the steps of connecting

to the terminal to the server at the address contained in the header, downloading the identified application when the identified application was not available on the terminal, and starting the identified application when
5 downloaded.

Thus, the required application can automatically be downloaded if it is not already available on the terminal. Since the application is in platform
10 independent object code, there is no platform compatibility problems, and because the download address is contained in the header the user does not need to search for it.

15 Preferably, the message body contains data to be used by the identified application.

The platform independent object code can be Java™, in particular Java™ 2 Platform, Micro Edition (J2METM) from
20 Sun Microsystems Inc. but other platform independent object codes can be used.

The virtual machine preferably is a K Virtual Machine™ (KVM). The identified application can be a Java™
25 application, a Java™ applet or a Java™ MIDlet.

The devices and method described below provide for a mobile communication terminal that can operate with a flexible messaging concept for a wireless network.
30 This terminal has native software and a virtual machine. The virtual machine is capable of executing applications in platform independent object code. The terminal also has a message handling application in the native software or in an application run by the virtual machine. The
35 message handling application is capable of sending and receiving messages via the wireless network, and the

message handling application is programmed to start an application written in the independent object code when a corresponding identifier is contained the header of a received message.

5

Thus, the terminal is able to automatically start the application required for using the data in the message body of a received message, regardless of the type and version of the native software of the terminal if the required application is available on the terminal.

The message handling application can also be programmed to download the identified application from a server that is accessible via the wireless network at an address contained in the header when the identified application is not already available on the terminal.

The message handling application is programmed to verify the certification of the downloaded application.

20

The mobile communication terminal may further comprise an application identifier database listing the identifiers of all the applications in platform independent object code that are available on the terminal.

25

The message to be used with a flexible messaging concept for mobile terminals that operate on a wireless network is describe in detail below, and provides a format suitable for transmission through a wireless network to a mobile communication terminal, the terminal having native software and an virtual machine capable of handling platform independent object code and the message having a syntax comprising a header part and message body part. The header contains an identifier for an application in platform independent object code to be executed by the

35

virtual machine in the mobile communication terminal that receives the message.

Preferably, the header includes an address at which the
5 identified application can be downloaded from a server that is accessible through the wireless network. The message body may contain data to be used by the identified application.

10 The message header may include a URI that serves as identifier and contains the address at which the identified application can be downloaded from a server.

The message can be an SMS message with a port address in
15 octets 4-5 that identifies it as a message containing an identifier for an application in platform independent object code to be started upon receipt of the message. The identified application can be a Java™ applet or MIDlet, preferably in the Java™ 2, Micro Edition, Mobile
20 Information Device Profile (MIDP) format.

The message may also contain a signed certificate issued by a recognized certification authority and including a public key from the signatory. In addition, the message
25 may include field communication of an unique sender identifier in the form of a telephone number of an originating mobile phone, or other unique identifier for mobile terminals and/or computers.

30 On this background, it is an object of the present invention to provide.

With the system described herein, a flexible messaging method for mobile terminals that operate on a wireless
35 network achieved by providing a method of enabling an application in platform independent object code to be run

on a mobile communication terminal comprising the steps of sending a message from a server via the wireless network to a mobile communication terminal, the terminal being provided with a virtual machine capable of
5 executing applications in platform independent object code. The message contains a header with an identifier for the application to be started on the mobile communication terminal and a message body with the data to be used by the identified application.

10

Thus, the system and methods described herein make it possible to send a message with data to be used by a specific application to a mobile communication terminal, without needing to know first which platform is installed
15 in the terminal.

The message header may further contain an address at which the identified application can be obtained from a server that is accessible through the wireless network,
20 and thus the method may further comprise the step of uploading the identified application to the mobile communication terminal when the mobile terminal connects to the server at the address in the header.

25 Thus, it is rendered possible to transfer an application to a mobile terminal without being required to know the platform installed on the terminal. There is also no risk of installing the application twice on the same terminal.

30

Further objects, features, advantages and properties of the flexible messaging system according to the invention will become apparent from the detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following detailed portion of the present description, the invention will be explained in more
5 detail with reference to the exemplary embodiments shown in the drawings, in which

Fig. 1 shows the architecture of a wireless cellular communication network for use with the present invention,
10 Fig. 2 shows a mobile phone in accordance with the present invention,
Fig. 3 is a block diagram showing the basic components of the mobile phone of Fig. 2,
Fig. 4 shows the software architecture of the mobile
15 phone of Fig. 2,
Fig. 5 is a flowchart illustrating the message handling procedure according to a preferred embodiment of the present invention,
Fig. 6 shows a sequence diagram of an example of the use
20 of the flexible messaging system according to the invention, and
Fig. 7 shows a sequence diagram of a further example of the use of the flexible messaging system according to the invention.

25

DETAILED DESCRIPTION

Fig. 1 illustrates a network architecture for use with the present invention. The telecommunication system
30 includes a wireless cellular network 16 and a data network 24. The wireless cellular network 16 can be implemented in a conventional wireless cellular telephone network that has been enhanced to carry data. A wireless network capable of carrying circuit-switched data can be
35 used for this purpose. More preferably, however, the wireless cellular network provides a packet-switched data

service. An example of a wireless infrastructure includes UMTS (Universal Mobile Telephone System), a 3rd Generation wireless system based on GSM (Global System for Mobile communications). GSM adds a packet network overlay known as GRPS (GSM Packet Radio Service) to a wireless circuit voice network. The data network can e.g. be the Internet.

The cellular network comprises a large number of base stations 20 (only two are shown) that are provided with a transceiver for handling mobile phone communications. The base stations 20 are connected to a mobile switching centre 21. Each of the base stations 20 has its own control channel frequency (control channel frequencies can be reused for distant cells).

The base stations 20 are provided with an SMS/MMS message controller (not shown) and an SMS/MMS message transmission driver to allow it to send message to a mobile phone 1 and to receive messages from a mobile phone 1.

The mobile switching centre 21 is connected to a data 22 switching node that connects the cellular communication network 16 with the data network 24. Different servers 25,26,27,28 described in more detail below, are connected to the data network.

Fig. 2 shows a preferred embodiment of a mobile phone 1 according to the invention. The mobile phone 1, comprises a user interface having a keypad 2, a display 3, an on/off button 4 (present in the top of the phone) a speaker 5, and a microphone 6 (only the opening present in the bottom of the phone is visible). The mobile phone 1 according to the preferred embodiment is adapted for communication via a cellular network, such as the GSM

900/1800 MHz network, but could just as well be adapted for use with a Code Division Multiple Access (CDMA) network.

5 According to a preferred embodiment, the keypad 2 has a first group 7 of keys as alphanumeric keys, two softkeys 9, a cursor navigation key 10 (scroll up/down), and on-hook and off-hook keys 12. The present functionality of the softkeys 9 is shown in separate fields (softkey-
10 labels) in the display 3 just above the softkeys 9. The softkeys 9 are multifunction keys and their present function depends on the state of the mobile phone 1. The softkeys 9 give access to the menu, the phonebook and call can activate actions related to call handling and
15 message handling. A releasable battery pack 14 is placed on the rear side of the mobile phone 1.

Fig. 3 schematically shows the most important components of a preferred embodiment of the mobile phone 1, said
20 components being essential to the understanding of the invention. The processor 18 controls the communication with the network via the transmitter/receiver circuit 19 and an internal antenna 15.

25 The microphone 6 transforms the user's speech into analogue signals, the analogue signals formed thereby are A/D converted in an A/D converter (not shown) before the speech is encoded in a digital signal processing unit 14 (DSP). The encoded speech signal is transferred to the
30 processor 18, which i.e. supports the GSM terminal software. The processor 18 also forms the interface to the peripheral units of the apparatus, including a RAM memory 17a and a Flash ROM memory 17b, a SIM card 16, the display 3 and the keypad 2 (as well as data, power
35 supply, etc.). The DSP 14 speech-decodes the signal,

which is transferred from the processor 18 to the speaker 5 via a D/A converter (not shown).

Fig. 4 illustrates the software architecture of the mobile phone 1. The software architecture comprises an operating system, in a preferred embodiment the Symbian™ 7.0 OS that provides the platform for the native software. The native software comprises a number of native applications of which a few can be mentioned: User interface, KVM support, a call handling, phone book, message handling and a MIDlet database. The listed native applications are, however, merely exemplary, there could be more as well as fewer native applications.

A Connected Limited Device Configuration (CLDC) provides the runtime environment for Java™ applications. CLDC is one of the most appropriate configurations for mobile phones available for Java™, since it is tailored for devices with 160-512 KB memory battery powered, slow, possibly intermittent, connection.

The CLDC comprises a K Java™ Virtual Machine (KVM) and a set of libraries and Application Program Interfaces (APIs). The libraries and APIs are specified in the Mobile Information Device Profile (MIDP) sitting on top of the CLDC. The MIDP is a vertical extension of CLDC. Together they provide a run-time environment for Java™ Applets and MIDlets (MIDlet: an application written for the Mobile Information Device profile (MIDP)) on the mobile phone concerned.

The MIDlets are in code that is created by a Java™ compiler. This code can be run on any platform that has a KVM installed. A MIDlet will run the same in any KVM, regardless of the hardware and software underlying the system. The MIDLETS are therefore ideal for extending

the functionality of mobile phones, also because their relatively small size renders them suitable for downloading to the phone. In the present embodiment, a calculator MIDlet and two other MIDlets X2 and X3 have
5 been downloaded to the mobile phone 1. The MIDlets co-exist with other applications on the mobile phone 1 such as the Original Equipment Manufacturer (OEM) Specific Applications. In the present embodiment a Java™ xhtml micro browser applet has been installed by the OEM.

10

The message handling application is capable of receiving, creating and sending text messages in the SMS standard (Short Message Service (SMS) part of the Global System for Mobile communications (GSM) digital standard - well
15 known in the art). The message handling application may also be able to handle other message formats for exchanging information between mobile phones/servers such as the more recent MIME (Multipurpose Internet Mails Extensions) and MMS (Multimedia Messaging Service)
20 standards. The message handling application may run in the native software or in an application run by the virtual machine.

The mobile phone 1 can send and receive data using the
25 General Packet Radio Service (GRPS) for e.g. downloading MIDlets or other applications and is Wireless Application Protocol (WAP) enabled. A micro-browser written in Java™ is one of the OEM-specific applications.

30 The present invention provides for a new SMS message type in which the message header contains a MIDlet identifier and an address at which the identified MIDlet can be downloaded from a server that is connected to the wireless cellular network. This header is in addition
35 the now-standard SMS header and the user data header. The message body contains the data to be used by the

identified MIDlet. The new SMS message type will be referred to hereafter as a Java-message (J-SMS).

The syntax of the J-SMS in a preferred embodiment is as follows:

```

<sms> ::=
    <sms-header>
    <sms-data>
10
<sms-header> ::= standard sms header described somewhere
else
<sms-data> ::=
    <user-data-header>
15    <user-data>
    <user-data-header> ::= user data header as described in
    smart messaging specification
    <user-data> ::=
        <j-sms-header>
20        <j-sms-data>
    <j-sms-header> ::=
        <j-sms-header-length>
        <j-sms-version>
        <j-sms-flags>
25        <j-sms-uris>
        <j-sms-certificates>
    <j-sms-header-length> ::= two bytes giving the length of
    the j-sms header
    <j-sms-version> ::= one byte with the version of the j-
30 sms protocol (01)
    <j-sms-flags> ::= one byte with flags for the message.
    Sum of the following:

```

1: the message includes certificates and a
 checksum
 2: the message can be displayed as text
 4: the message can be discarded if not
 5 able to display
 <j-sms-uris>::=
 <number of uris>
 <uri_s>*
 <number of uris>::=one byte with the number of uris
 10 <uri_s>::=uri's terminated with \n
 <j-sms-certificates>
 <checksum>
 <certificate>*
 <checksum>::=checksum of the whole user data block
 15 (user data header plus user data) excluding this
 checksum
 <certificate>::=certificate in base64 encoding
 terminated by \n
 <j-sms-data>::=data that is to be transferred to the
 20 MIDlet

An example of a J-SMS in accordance with a preferred
 embodiment of the present invention in the form of an
 application port addressing scheme as defined in GSM
 25 03.40 is listed below:

Octet Number	Value	Description
1	0B	Length of the User Data Header
2	05	Information Element Identifier (IEI; application port addressing scheme, 16-bit port address)
3	04	Information Element Data Length (IEDL)
4 - 5	2136	Information Element Data (octets 4 & 5 → 2136 - destination port)

6 - 7	00 00	Information Element Data (octets 6 & 7 → 0000 - originator port)
8	00	Information Element Identifier (IEI; concatenated short message, 8-bit reference number)
9	03	Information Element Data Length (IEDL; 3 octets)
10	01	Information Element Data (concatenated short message reference number)
11	02	Information Element Data (total number of concatenated messages (0-255))
12	01	Information Element Data (sequence number of current short message)
13	30	MIDlet message version number. ISO-8859-1 character "0"
14	00	Message flags where the following bits have the meaning: <ul style="list-style-type: none"> 1. message includes certificate 2. message data can be displayed as text 3. message can be discarded if not able to display 4. reserved for future use.
15	01	Number of following URIs
16..	"http://www.d2.de/greetingcard.java"	The URI of the MIDlet used to display the content. Terminated by a newline (0x0A) character.
..	http://www.d2.de/greeting/picture1.jpg "Hi there, how are you doing ?".	MIDlet message data in a format defined only by the MIDlet.

The port number in octet 4-5 defines the SMS message type. The number used in this example is arbitrary and has not been reserved for the message type according to the present invention. Regular port numbers are reserved in the NBS port number space at the Internet Assigned Numbers Authority (IANA).

Octets 1 to 12 are in use in conventional SMS types, and for further information on their function reference is made to the GSM 03.40 specification, hereby incorporated by reference.

5 Octet 13 identifies the MIDlet message version number.

Octet 14 contains message flags where the following bits have the meaning:

1. message includes certificate
2. message data can be displayed as text
- 10 3. message can be discarded if not able to display
4. reserved for future use.

Octet 15 defines the number of Uniform Resource Identifiers (URIs) contained in the message. Octet 16
15 contains the first URI, followed by the message body with the data to be used by the identified MIDlet.

The message handling application detects the message type through the port number in octet 4-5. If the port number is (in present example) 2136 (HEX) the message is treated
20 as a J-SMS. SMS messages with other port numbers in octet 4-5 are handled by the message handling application in the respective intended way, which is though not described here since this other types of the message handling are well known from e.g. the SMART MESSAGING
25 SPECIFICATION, Revision 3.0.0, 2000-12-18, hereby incorporated by reference.

The MIDlet to be executed upon receipt of the message is defined by the URI in octet 16. The data to be used
30 during the execution of the identified MIDlet is contained in the message body in the following octets. The data may comprise image files, formatted text files, audio files database files, or any other type of file executable on the terminal, or it may contain links to

such files. Referring to the table, greeting card MIDlet identified in octet 16 is needed to display the greeting card which includes an image file and associated text. The greeting card image file "picture1.jpg" is provide by
5 an identification of the URI "http://www.d2.de/greeting/picture1.jpg," and the accompanying text "Hi there, how are you doing?" is provided as a text file within the message itself.

10 The following example illustrates the practical application of the J-SMS type messages. A first mobile subscriber A wishes to send his friend, mobile subscriber B, an e-postcard. Subscriber A visits the WAP-site of a postcard server 25 using the micro browser on his mobile
15 phone 1. There, he selects the type of e-postcard to be sent, e.g. the graphics, accompanying tune, animation, font type, color, etc. The server 25 prompts subscriber A to enter a message text, that may or may not be used in combination with text integrated in the selected e-
20 postcard. The server 25 also prompts subscriber A to enter the intended recipient's name and phone number. When the server 25 has received these data and an accept from subscriber A it sends a J-SMS to subscriber B. The header of the J-SMS contains an identifier for a postcard
25 displaying MIDlet, and an address where the postcard displaying MIDlet can be downloaded from a server, in this case a MIDlet server 26, but it could just as well have been the postcard server 25. The URI serves as MIDlet identifier and as download address.

30 The postcard displaying MIDlet is an application that displays the postcard as selected and composed by subscriber A correctly on any mobile device with a Java™ Virtual Machine. The postcard contains text and may
35 contain graphics, backgrounds, animations, music, etc.

The message body contains the data for the postcard displaying MIDlet.

Fig. 5 is a flowchart that illustrates the procedure
5 after dispatch of the J-SMS (step 51). Upon receipt of
the J-SMS by the mobile phone 1 of subscriber B (step 52)
the message handling application saves the message and
examines the message header (step 53), parsing the
10 message header for the information indicated in table
above. Then, the message handling application determines
the message type by checking the port number in octets 4-
5 (step 54).

If the message is not a J-SMS, but e.g. a profile or a
15 text message, the message handling application handles
the message accordingly (step 55), as is well-known in
the art and therefore not further explained here.

If the message handling application finds port number
20 2136 (HEX) in octet 4-5 the message is handled as a J-
SMS. The message handling application reads the first
URI included in the message. The URI serves as the
MIDlet identifier. The mobile phone 1 maintains a small
MIDlet database (one of the native applications) that
25 lists the URIs of all the MIDlets that have been
downloaded to the phone. The URI of OEM installed
MIDlets is preferably also listed in the MIDlet database.
The message handling application checks the MIDlet
database for the presence of the URI included in the
30 header (step 56).

After checking the MIDlet database, the message handling
application can determine (step 57) if the identified
MIDlet, in this example the postcard displaying MIDlet,
35 is available on the mobile phone 1.

If the identified MIDlet is available, the message handling application starts the postcard displaying MIDlet (step 58). The message handling application then sends the data in the message body to the postcard displaying MIDlet (step 59) which uses it to display the postcard as selected and composed by subscriber A, including the image on the picture1.jpg file and the personal text "Hi there, how are you doing?" (step 59A in Figure 5).

10

If the URI identified MIDlet was not found in the MIDlet database in step 56, the message handling application connects e.g. via GPRS to the address in the URI at which the identified midlet can be downloaded and downloads the identified MIDlet. In this example the postcard displaying MIDlet is downloaded from the MIDlet server 26 (step 60). In the download request the message handling application may provide information about the requesting phone. The MIDlet sever 26 uploads the postcard handling MIDlet to the mobile phone 1.

Next, the message handling application adds the URI of the downloaded MIDlet to the MIDlet database and verifies that the certificate accompanying the MIDlet is signed and issued by an recognized certificate authority to ensure the integrity of the MIDlet (step 61).

A certificate issued by a recognized certificate authority is added to the signed MIDlet. The carrier, or the software developer, creates a signing-key pair and obtains a certificate from a recognized certificate authority. The carrier or developer computes a signature of the MIDlet suite JAR, then places that signature and the corresponding certificate in the application descriptor.

The signed MIDlet suite assures the user that the contents of the MIDlet suite have not been tampered with, and that the MIDlet suite comes from an trusted source. The MIDP implementation on the device can verify the
5 identity of the developer by verifying the developer's signature. It can use the developer's public key added to the Java Application Descriptor (JAD) to verify the integrity of the MIDlet suite itself. For further details on the certification of MIDlets reference is made
10 to the MIDP 2.0 specification (hereby incorporated by reference).

The MIDlet is then handled in accordance with the permission levels indicated in the certificate. The
15 permissions may comprise allowed permissions and user permissions (the ones for which the user will be consulted). The permission levels are stepped in the following order: Network operators (highest level), OEM (mid level), signed but not by Network operator or OEM
20 (lowest level). Depending on these levels the phone prompts for permission for sensitive operations to e.g. opening an HTTP connection, to delete or change phone numbers, etc.

25 After the certificate verification the message handling application starts the postcard displaying MIDlet (step 58), sends the data in the message body to the postcard displaying MIDlet (step 59) and the postcard is displayed.

30

The procedure can be repeated if subscriber B replies by sending an e-postcard back to subscriber A, a function that may be built into the postcard displaying application. Otherwise, the message handling application
35 ends in step 62.

There can be more than one MIDlet identifier (URI) included in a single J-SMS. The message application will execute the identified MIDlets in the order in which they are listed in the J-SMS. In the above example the URI
5 has been used both to identify the MIDlet and to provide the address at which the MIDlet can be downloaded. It is however possible to use a separate identifier and address. The MIDlet that is started by the J-SMS may also download further information or other data.

10

Another example of the use of the present invention is illustrated in Fig. 6 with the following scenario. An e-mail provider wishes to send e-mail messages to mobile subscribers. The standard SMS e-mail message is not
15 sufficient for the operator's requirements because more features should be implemented e.g. starting an xhtml browser to read the e-mail, displaying the header of the new received e-mail, displaying the provider logo, showing an in-tray with received e-mails in every user's
20 e-mail folder. After receipt of an e-mail intended for a mobile subscriber, the operator's e-mail server 27 sends a J-SMS that starts a MIDlet that displays the text "e-mail received" on the display of the mobile phone together with an audible notification and prompts the
25 user if the e-mail should be opened. If the user affirms but the required enhanced e-mail MIDLET (an xhtml Java™ browser) is not installed on the user's mobile phone, the mobile phone requests a download of the enhanced e-mail MIDlet from the URI listed in the e-mail message,
30 processes the download to install the enhanced e-mail MIDLET, and thereafter executes the enhanced e-mail MIDLET to process the e-mail data. The xhtml browser exchanges e-mail data via GPRS between the mobile phone 1 and the e-mail server 27 and displays the e-mail data.
35 The xhtml browser operates as a sophisticated e-mail client that offers the user more flexibility and comfort

than the simple e-mail displaying capacities of conventional SMS. The steps of requesting the MIDlet from the MIDlet server and the subsequent download as shown in Fig. 6 are bypassed if the xhtml browser MIDlet
5 is already available on the mobile phone 1.

A further example of the use of the present invention is illustrated in Fig. 7 with the following scenario. A network operator wishes to offer a new service to its
10 customers. This new service sends special offers from the operator's web-shop to the mobile phone of the customers. This service is realized by the provider sending J-SMSs including name, price and description (photo) of the offered items from its web-shop server
15 (e.g., block 28 of Figure 1). The J-SMS includes an identifier of an advertisement displaying MIDlet that displays this information in a clean way, stores past offers for reference and allows the subscriber to order the items at the web-shop. The steps of requesting the
20 MIDlet from the MIDlet server and the subsequent download as shown in Fig. 7 are bypassed if the advertisement displaying MIDlet is already available on the mobile phone 1.

25 The integrity verification does not need to be exclusively applied to the MIDlets, it can also be implemented in the J-SMS itself by adding a certificate from a recognized certificate authority and an encrypted checksum of the whole message to the J-SMS. The validity
30 of the certificate can be verified by opening the signature with the public key that is included in the J-SMS. In this embodiment of the J-SMS the verification can be carried out before downloading the MIDlet concerned. Thus, some unnecessary downloads of
35 uncertified MIDlets can be avoided.

As illustrated above, the messaging system provides a message format for use in a mobile phone system wherein mobile phones are capable of running a variety of applications to process a variety of files, and are
5 capable of running a message handling application for receiving messages. The message format comprises a header portion for identifying the message to the message handling application and a message data portion. The message data portion further comprises (1) a message data
10 file portion which may optionally contain message text files, message images, message audio, message database files or the like, or identification of message files and locations from which said message files or the like may be downloaded to the phone, as desired by the originator
15 of the message and (2) a message data header portion which contains an identification for any application needed in order to process files contained or identified in the message data file portion, and also contains information regarding locations from which said
20 application may be downloaded to the phone. In addition, the message format may comprise a user data header according the SMS specification, and various other headers as dictated by the particular message contents.

25 Although the present invention has been described in detail for purpose of illustration, it is understood that such detail is solely for that purpose, and variations can be made therein by those skilled in the art without departing from the scope of the invention. The message
30 type is not limited to the SMS standard, and may be implemented in MMS or EMS standards. The applications that are executed after receipt of a message do not need to be MIDlets, they could just as well be Java™ applets or other applications in platform independent code. The
35 platform independent runtime environment does not need to be Java™ based, other runtime environments for platform

independent code can be used. Thus, while the preferred
embodiments of the devices and methods have been
described in reference to the environment in which they
were developed, they are merely illustrative of the
5 principles of the inventions. Other embodiments and
configurations may be devised without departing from the
scope of the appended claims.

CLAIMS:

1. A method of handling incoming messages received on a mobile communication terminal via a wireless network, the terminal having native software and a virtual machine
5 capable of executing platform independent object code, comprising the steps of:

receiving and storing a message that comprises a header and a message body, the header containing an identifier for an application in platform
10 independent object code that can be executed by the virtual machine,
verifying if the identified application is available on the terminal, and
starting the identified application when available
15 on the terminal

2. A method according to claim 1, wherein the header further contains an address at which the identified application can be downloaded from a server that is accessible through the wireless network, and further
20 comprising the steps of:

connecting to the terminal to the server at the address contained in the header and downloading the identified application when the identified application was not available on the terminal, and
25 starting the identified application when downloaded.

3. A method according to claim 1, wherein the message body contains data to be used by the identified application.

4. A method according to claim 2, wherein the message body contains data to be used by the identified application.
5. A method according to claim 3, wherein the message body contains greeting card data that is to be used by a greeting card displaying application identified in the header.
6. A method according to claim 4, wherein the message body contains greeting card data that is to be used by a greeting card displaying application identified in the header.
7. A method according to claim 3, wherein the message body contains phone number data that is to be used by a phonebook updating application identified in the header.
8. A method according to claim 4, wherein the message body contains phone number data that is to be used by a phonebook updating application identified in the header.
9. A method according to claim 3, wherein the message body contains e-mail data that is to be used by an e-mail displaying application identified in the header.
10. A method according to claim 4, wherein the message body contains e-mail data that is to be used by an e-mail displaying application identified in the header.
11. A method according to any of claims 1 to 10, wherein the platform independent object code is Java™, preferably in the Java™ 2, Micro Edition format.
12. A method according to any of claims 1 to 10, wherein the virtual machine is a Java Virtual Machine, preferably a K Virtual Machine™ (KVM) .

13. A method according to any of claims 1 to 10, wherein the identified application is a MIDlet.

14. A method according to any of claims 1 to 10, further comprising the step of verifying the certification of the
5 identified application.

15. A mobile communication terminal for operation with a wireless network, the terminal having:

native software,

10 a virtual machine capable of executing platform independent object code,

a message handling application in the native software or in an application under the virtual machine, the message handling application being capable of sending and receiving messages via the
15 wireless network, and

the message handling application being programmed to start an application written in the independent object code when a corresponding identifier is contained the header of a received message.

20 16. A mobile communication terminal according to claim 15, wherein the message handling application is programmed to download the identified application from a server that is accessible via the wireless network at an address contained in the header when the identified
25 application is not already available on the terminal.

17. A mobile communication terminal according to claim 15, wherein the platform independent object code is Java™, preferably in the Java™ 2, Micro Edition format.

18. A mobile communication terminal according to claim 17, wherein the virtual machine is a Java™ Virtual Machine, preferably a K Virtual Machine™ (KVM).
19. A mobile communication terminal according to any of
5 claims 15 to 18, wherein the identified application is a MIDlet.
20. A mobile communication terminal according to any of claims 15 to 18, wherein the message handling application is programmed to verify the certification of the
10 downloaded application.
21. A mobile communication terminal according to any of claims 15 to 18, wherein the message application is programmed to send the data in the message body to the identified application.
- 15 22. A mobile communication terminal according to any of claims 15 to 18, further comprising an application identifier database listing the identifiers of all the applications in platform independent object code that are available on the terminal.
- 20 23. A message for transmission through a wireless network to a mobile communication terminal, the terminal having native software and a virtual machine capable of executing applications in platform independent object code, the message having a syntax comprising:
- 25 a header part, and
- a message body part,
- the header containing an identifier for an application in platform independent object code to be executed by the virtual machine on the mobile
30 communication terminal that receives the message.

24. A message according to claim 23, wherein the header includes an address at which the identified application can be downloaded from a server that is accessible through the wireless network.
- 5 25. A message according to claim 23 or 24, wherein the message header contains a URI that serves as identifier and contains the address at which the identified application can be downloaded from a server.
26. A message according to any of claims 23 or 24,
10 wherein the message body contains data to be used by the identified application.
27. A message according to any of claims 23 or 24, wherein the message is an SMS message with a port address in octets 4-5 that identifies it as a message containing
15 an identifier for an application to be started upon receipt of the message.
28. A message according to any of claims 23 or 24, wherein the identified application is a Java™ applet or a MIDlet, preferably in the Java™ 2, Micro Edition, Mobile
20 Information Device Profile (MIDP) format.
29. A message according to any of claims 23 or 24, further containing a signed certificate issued by a recognized certification authority that includes a public key from the signatory.
- 25 30. A method of enabling an application in platform independent object code to be run on a mobile communication terminal comprising the steps of:
- 30 sending a message from a server via the wireless network to the mobile communication terminal that is provided with a virtual machine capable of executing applications in platform independent object code, the message containing:

a header with an identifier for the application to be executed by the virtual machine and

a message body with the data to be used by the identified application.

5 31. A method according to claim 30, wherein the message header further contains an address at which the identified application can be obtained from a server that is accessible through the wireless network, further comprising the step of:

10 uploading the identified application to the mobile communication terminal when the mobile terminal connects to the server at the address contained in the header.

32. A method according to claim 30, wherein the server
15 that uploads the identified application is not the same as the server sending the message.

33. A method according to claim 30, wherein the uploaded application is a MIDLet, preferably in the Java™ 2, Micro Edition, Mobile Information Device Profile (MIDP) format.

20 34. A message format for use in a mobile phone system wherein mobile phones are capable of running a variety of applications to process a variety of files, and are capable of running a message handling application for receiving messages, said message format comprising:

25 a header portion for identifying the message to the message handling application;

a message data portion, said message data portion further comprising;

30 a message data file portion which may optionally contain message text files, message images,

message audio, message database files or the like,
or identification of message files and locations
from which said message files or the like may be
downloaded to the phone, as desired by the
5 originator of the message; and

a message data header portion, wherein said
message data header portion contains an
identification for any application needed in order
to process files contained or identified the
10 message data file portion, and also contains
information regarding locations from which said
application may be downloaded to the phone.

35. A method of transmitting messages to a mobile phone
in a mobile phone system wherein mobile phones are
15 capable of running a variety of applications to process a
variety of files, and are capable of running a message
handling application for receiving messages; said method
comprising the steps of:

creating a message in a message format comprising:

20 a header portion for identifying the message to
the message handling application

a message data portion, said message data portion
further comprising;

25 a message data file portion which may
optionally contain message text files, message
images, message audio, message database files
or the like, or identification of message files
and locations from which said message files or
the like may be downloaded to the phone, as
30 desired by the originator of the message; and

a message data header portion, wherein said
message data header portion contains an

identification for any application needed in order to process files contained or identified the message data file portion, and also contains information regarding locations from which said application may be downloaded to the phone; and

transmitting the message to a mobile phone.

36. A method of operating a mobile phone comprising;

10 programming the phone to receive messages having a format such that the messages comprise an SMS header portion and an SMS data portion, wherein the SMS data portion comprises a first portion comprising message handling information and a
15 second portion comprising message data for eventual display to the mobile phone user, wherein the message handling information comprises information identifying an application needed to display the message data or otherwise process the
20 message data with an application, and information identifying a location from which the application may be downloaded to the phone; and wherein the message data comprises message files comprising message text files, message images, message audio,
25 message database files or the like, or identification of locations from which said message files or the like may be downloaded to the phone;

further programming the phone to determine if the
30 application needed to display or otherwise use the message data is installed on the phone, and, if not, to download the application from the

location identified in the message handling
information;

5 further programming the phone to display or
otherwise use the message files or the like if
they are already in the message data, or, if not,
to download the message files from the locations
identified in the message data;

operating the phone to receive a message, and
thereafter operating the phone to determine if the
10 application needed to use the message files is
installed on the phone, and, if not, to download
the application; and thereafter operating the
phone to display or otherwise use the message
files if they are contained in the message data,
15 and, if not, to download the message files from
the location identified in the message data and
thereafter display or otherwise use the message
files.

37. The message format of claim 34 wherein the messages
20 are provided in an SMS format.

38. The message format of claim 34 wherein the messages
are provided in an MMS format.

39. The message format of claim 34 wherein the messages
are provided in an EMS format.

25 40. The method of claim 35 or 36 wherein the messages
are provided in an SMS format.

41. The method of claim 35 or 36 wherein the messages
are provided in an MMS format.

42. The method of claim 35 or 36 wherein the messages
30 are provided in an EMS format.

43. The message format of claim 34 wherein the message header is an SMS header, and wherein the message format further comprises a user data header.

44. The method of claim 35 further comprising creating
5 the message in a message format comprising a user data header.

45. The method of claim 36 wherein the message header is an SMS header, and wherein the message format further comprises a user data header.

10

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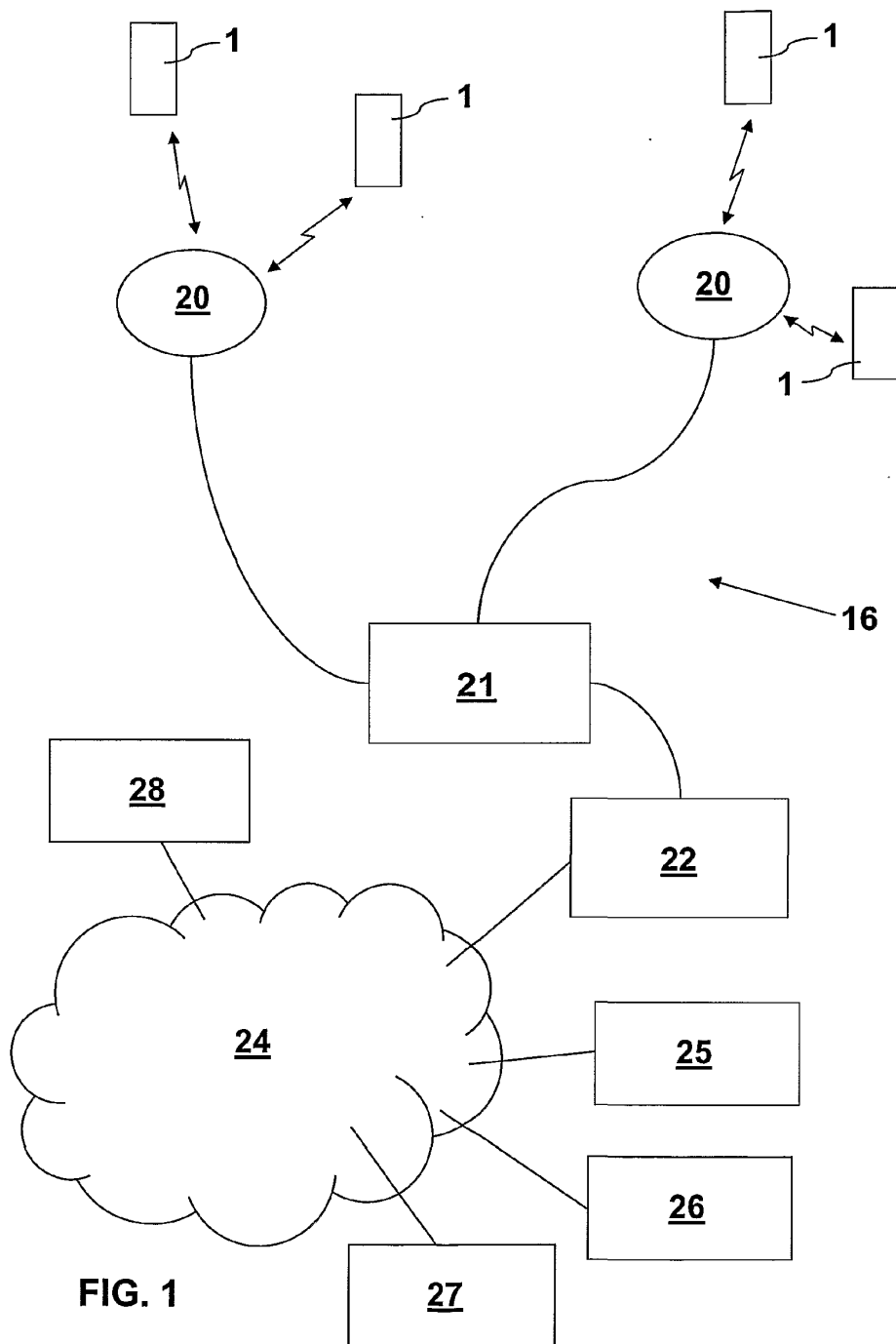
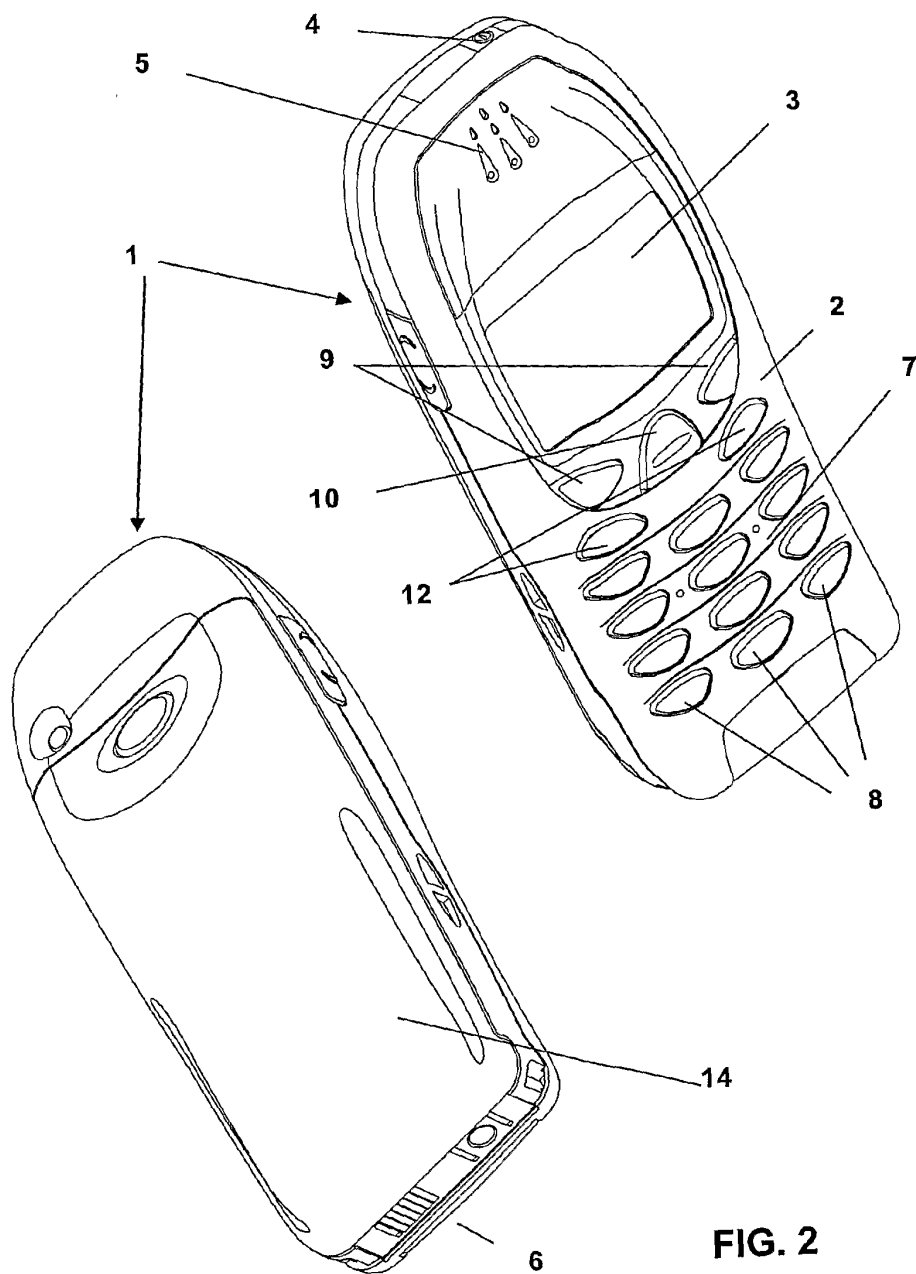


FIG. 1

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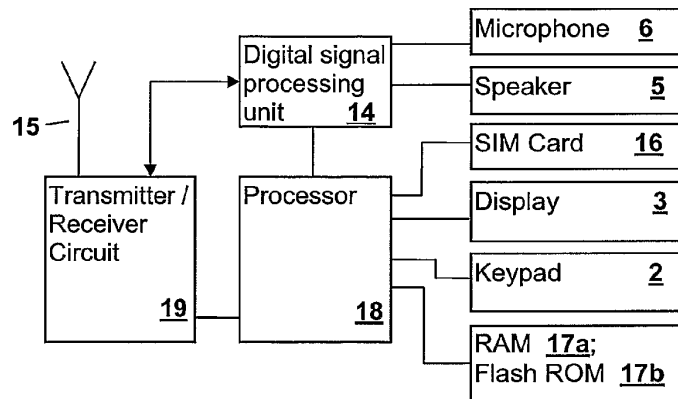
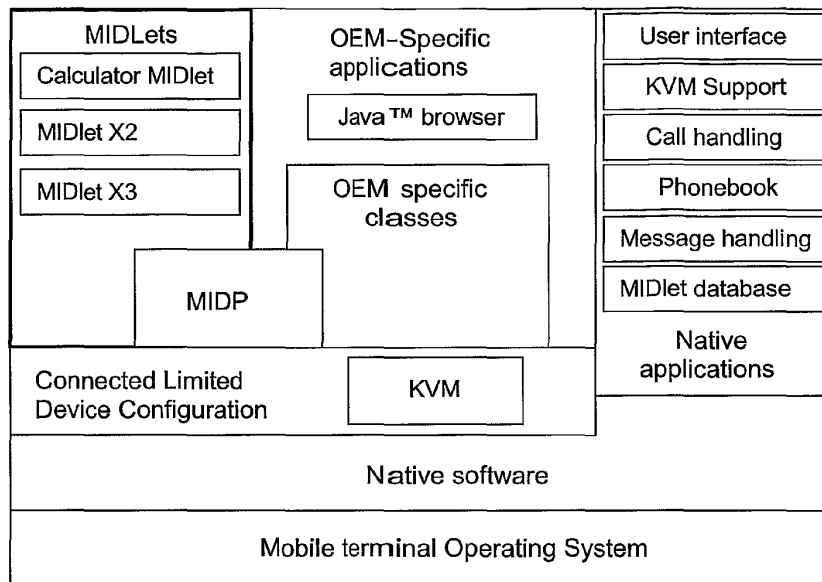


FIG. 3

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**FIG. 4**

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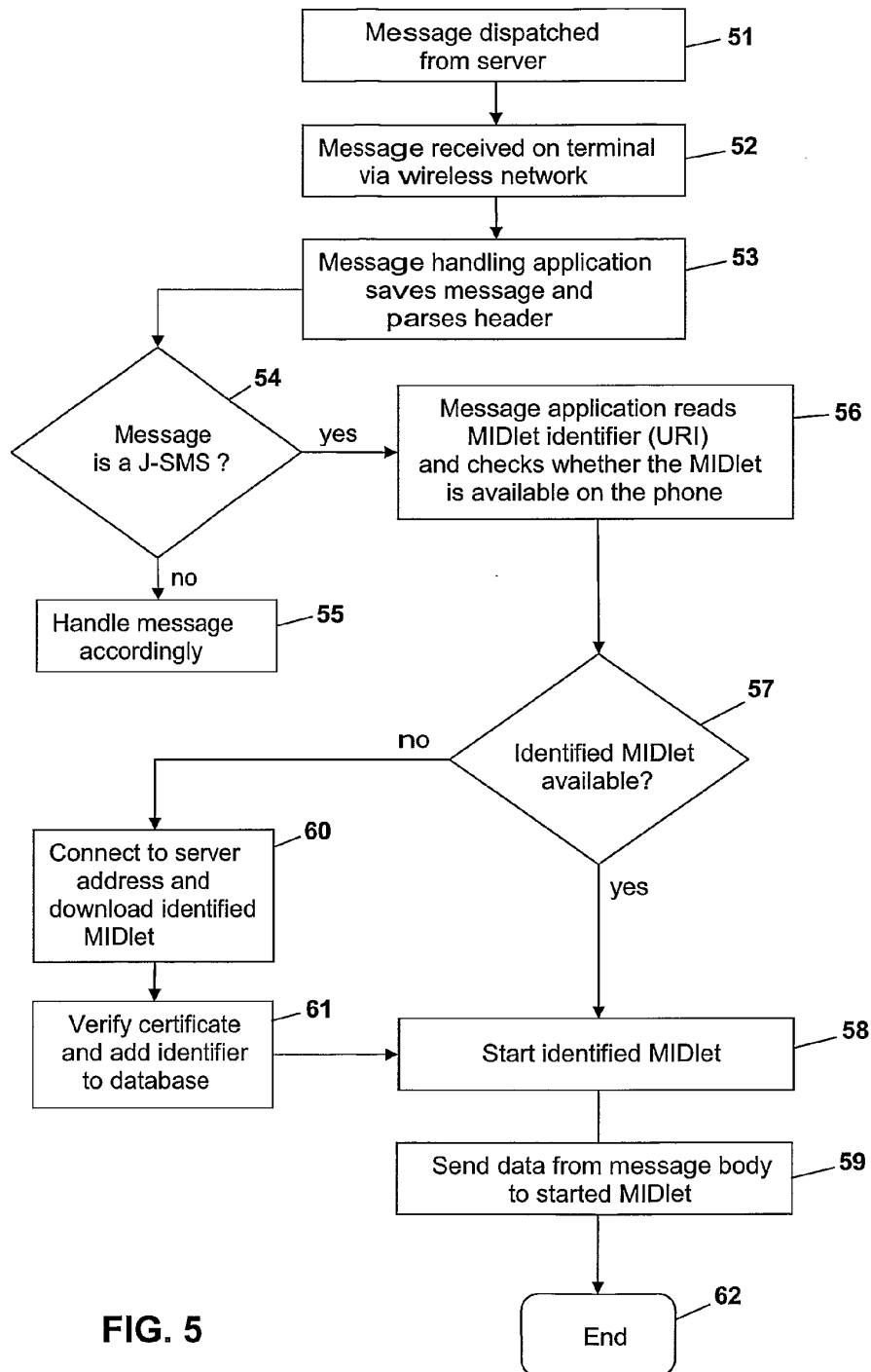


FIG. 5

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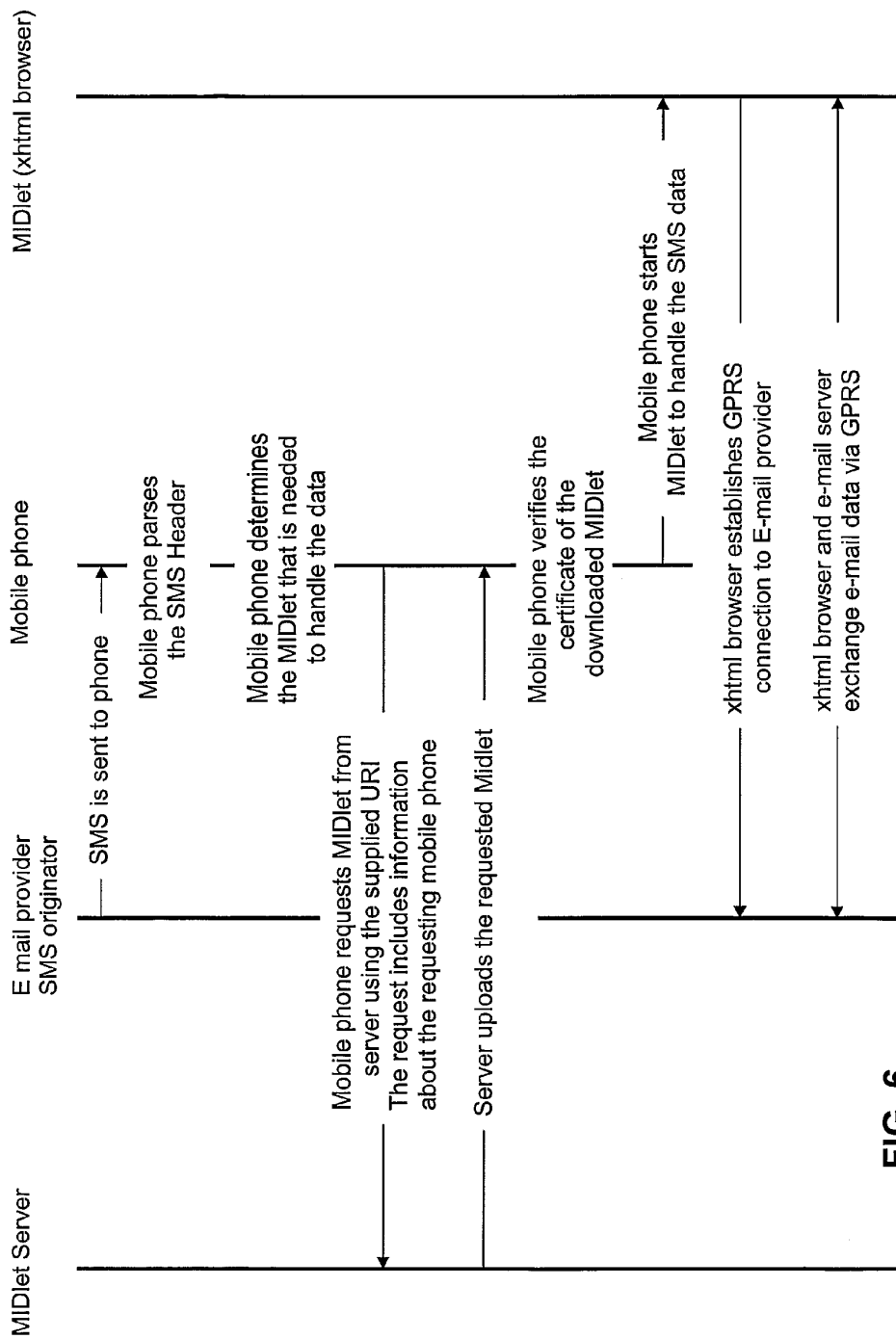


FIG. 6

7/7

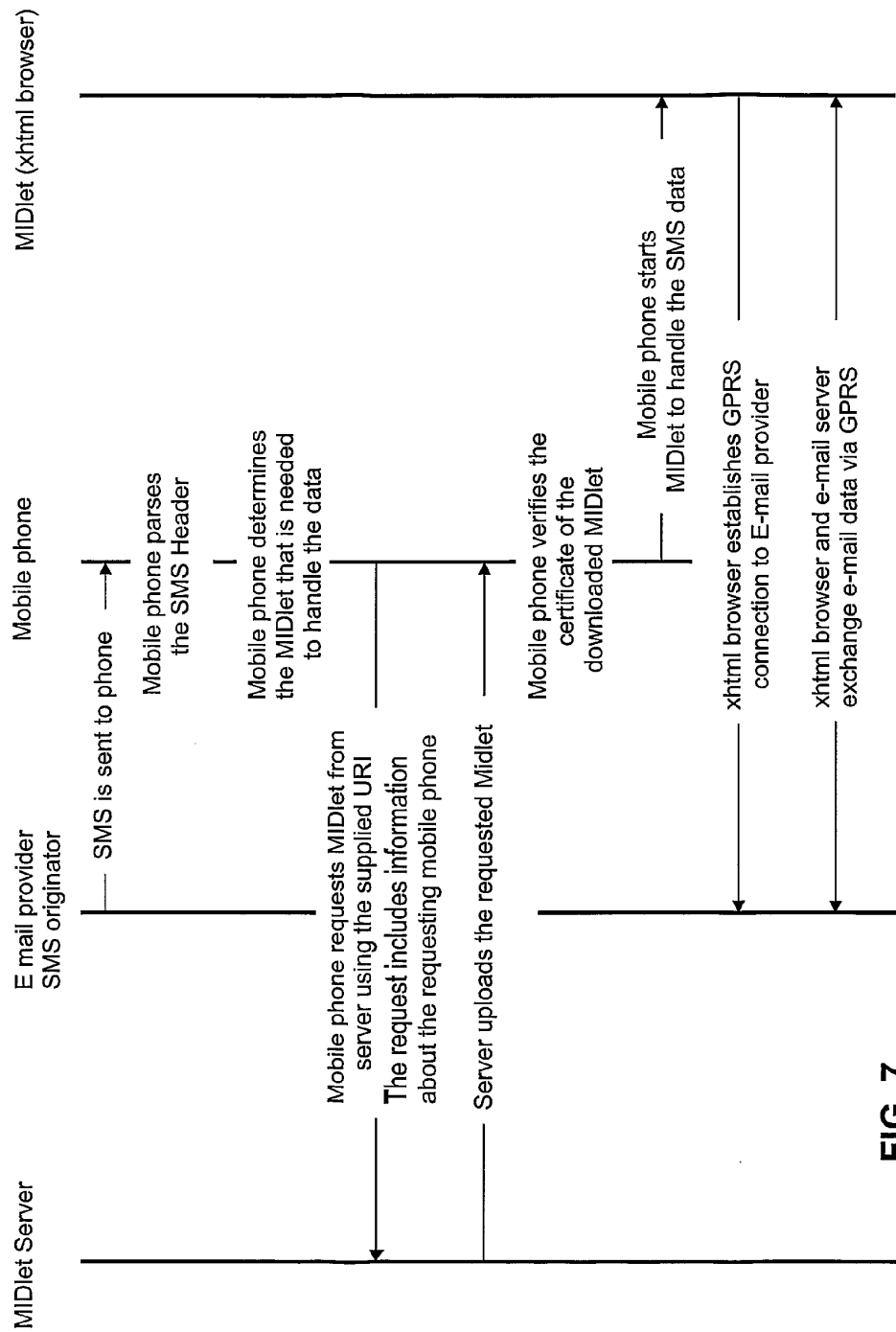


FIG. 7

INTERNATIONAL SEARCH REPORT

International Application No.
PG/EP2004/013101

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04Q7/32

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 7 H04Q

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

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

EPO-Internal, WPI Data, PAJ, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	<p>WO 98/34422 A (NOKIA MOBILE PHONES LIMITED; WELLS, MARK; HUBER, ROLF) 6 August 1998 (1998-08-06)</p> <p>page 5, line 4 - line 17 page 15, line 5 - page 17, line 2 page 27, line 7 - last line figure 4</p> <p style="text-align: center;">----- -/--</p>	<p>1,3,5,7, 9,11-15, 17-23, 26-30, 32,33</p>



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

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Date of the actual completion of the international search

11 March 2005

Date of mailing of the international search report

30/03/2005

Name and mailing address of the ISA

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page 1 of 2

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2004/013101

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	SONERA MEDIALAB: "Mobile Java Application Development White Paper" 'Online! 12 September 2002 (2002-09-12), , XP002320888 Retrieved from the Internet: URL: http://www.medialab.sonera.fi/workspace/MobileJavaAppDevelopment.pdf 'retrieved on 2005-03-10! Chapters 1 and 2	1,3,5,7, 9,11-15, 17-23, 26-30, 32,33
A	EP 1 143 688 A (CLIENT ELECTRONICS GMBH) 10 October 2001 (2001-10-10) page 2, paragraph 10 - page 3, paragraph 20 page 3, paragraph 25 - page 5, paragraph 44 figures 1-3,5	1-45
A	US 2002/123335 A1 (LUNA MICHAEL E.S ET AL) 5 September 2002 (2002-09-05) page 1, paragraph 13 - paragraph 14 page 2, paragraph 16 page 2, paragraph 21 - paragraph 23 page 3, paragraph 27 figure 2	1-45
A	US 2002/138545 A1 (ANDREAKIS DEAN W ET AL) 26 September 2002 (2002-09-26) page 1 - page 2, paragraph 10 page 2 - page 3, paragraph 19 page 3, paragraph 22 - paragraph 24	1-45

2

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page 2 of 2

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP2004/013101

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 9834422	A	06-08-1998	US 6125281 A AU 6214998 A WO 9834422 A2 EP 0956719 A2 JP 2001509981 T US 6078820 A	26-09-2000 25-08-1998 06-08-1998 17-11-1999 24-07-2001 20-06-2000
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Form PCT/ISA/210 (patent family annex) (January 2004)

Electronic Acknowledgement Receipt	
EFS ID:	29176414
Application Number:	15369542
International Application Number:	
Confirmation Number:	6887
Title of Invention:	System and Method for Wireless Network Offloading
First Named Inventor/Applicant Name:	Gregory G. Raleigh
Customer Number:	106963
Filer:	James E. Harris/Ann Taylor
Filer Authorized By:	James E. Harris
Attorney Docket Number:	RALEP049D1C1
Receipt Date:	10-MAY-2017
Filing Date:	05-DEC-2016
Time Stamp:	18:13:04
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	P049D1C1.pdf	1053964 a1366a8029125c844788e00c0269690a409cb597	no	4

Warnings:

Information:					
2	Foreign Reference	2093.pdf	3514622	no	45
			c65fb898082d5782c1d6c4ab30fd0d6f6ceb5ae6b		
Warnings:					
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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/369,542	12/05/2016	Gregory G. Raleigh	RALEP049D1C1

CONFIRMATION NO. 6887

PUBLICATION NOTICE



0C000000092294891

106963
Headwater Research LLC
1011 Pruitt Place
Tyler, TX 75703

Title:System and Method for Wireless Network Offloading

Publication No.US-2017-0181027-A1

Publication Date:06/22/2017

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The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently <http://www.uspto.gov/patft/>.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		15369542
	Filing Date		2016-12-05
	First Named Inventor	Gregory G. Raleigh	
	Art Unit	2464	
	Examiner Name	Ngo, Ricky Quoc	
	Attorney Docket Number	RALEP049D1C1	

U.S.PATENTS						Remove
Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1	6466984	B1	2002-10-15	Naveh et al.	
	2	6522629	B1	2003-02-18	Anderson, Sr., Ronald D.	
	3	6996062	B1	2006-02-07	Freed et al.	
	4	7269157	B2	2007-09-11	Klinker et al.	
	5	7340772	B2	2008-03-04	Panasyuk et al.	
	6	7423971	B1	2008-09-09	Mohaban et al.	
	7	7522576	B2	2009-04-21	Du et al.	
	8	7769397	B2	2010-08-03	Funato et al.	

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	Filing Date		2016-12-05
	First Named Inventor	Gregory G. Raleigh	
	Art Unit	2464	
	Examiner Name	Ngo, Ricky Quoc	
	Attorney Docket Number	RALEP049D1C1	

	9	7882247	B2	2011-02-01	Sturniolo et al.	
	10	7925740	B2	2011-04-12	Nath et al.	
	11	8010990	B2	2011-08-30	Ferguson et al.	
	12	8159520	B1	2012-04-17	Dhanoa et al.	
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	15	8619735	B2	2013-12-31	Montemurro et al.	
	16	8826411	B2	2014-09-02	Moen et al.	
	17	9015331	B2	2015-04-21	Lai et al.	
	18	9402254	B2	2016-07-26	Kneckt et al.	
	19	9634850	B2	2017-04-25	Taft et al.	

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	Filing Date		2016-12-05
	First Named Inventor	Gregory G. Raleigh	
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	1	20050111463	A1	2005-05-26	Leung et al.		
	2	20090149154	A1	2009-06-11	Bhasin et al.		
	3	20090291665	A1	2009-11-26	Gaskarth et al.		
	4	20110177811	A1	2011-07-21	Heckman et al.		

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	Filing Date	2016-12-05
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	Filing Date		2016-12-05
	First Named Inventor	Gregory G. Raleigh	
	Art Unit	2464	
	Examiner Name	Ngo, Ricky Quoc	
	Attorney Docket Number	RALEP049D1C1	

CERTIFICATION STATEMENT			
Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):			
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☐ See attached certification statement. The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.			
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A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.			
Signature	/James E. Harris/	Date (YYYY-MM-DD)	2017-08-11
Name/Print	James E. Harris	Registration Number	40013
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(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
31 January 2002 (31.01.2002)

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(10) International Publication Number
WO 02/08863 A2

- (51) International Patent Classification⁷: **G06F**
- (21) International Application Number: PCT/US01/23226
- (22) International Filing Date: 23 July 2001 (23.07.2001)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
60/220,241 21 July 2000 (21.07.2000) US
- (71) Applicant: **TELEMAC CORPORATION** [US/US];
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90045 (US).
- (72) Inventors: **WATLER, Theodore, W.**; 5341 E. 4th Street,
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- (74) Agents: **NG, Horace et al.**; Townsend and Townsend and
Crew LLP, Two Embarcadero Center, 8th Floor, San Fran-
cisco, CA 94111-3834 (US).

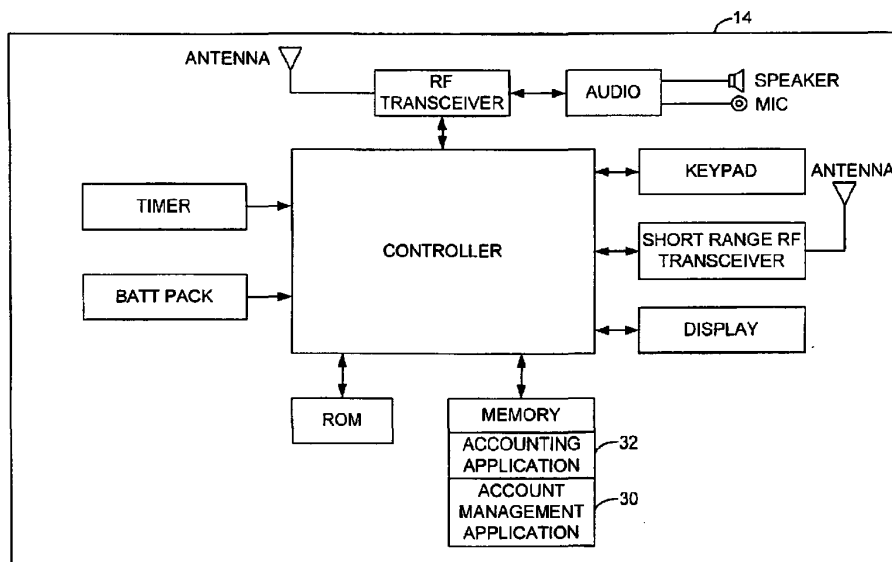
- (81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.
- (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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[Continued on next page]

(54) Title: MULTIPLE VIRTUAL WALLETS IN WIRELESS DEVICES



(57) Abstract: A system having a wireless device capable of monitoring and tracking its own usage and account activities is disclosed. The wireless device includes an account management application and accounting applications. The account management application manages a variety of accounts in conjunction with the accounting applications and is used by a user to determine how each call/transaction is to be paid for. For example, the user of the wireless device may wish to pay for business calls using a first account and personal calls using a second account.



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

MULTIPLE VIRTUAL WALLETS IN WIRELESS DEVICES

CROSS-REFERENCES TO RELATED APPLICATION

[01] This application claims the benefit of priority under 35 U.S.C. § 119 from
5 U.S. Provisional Patent Application Serial No. 60/220,241 filed on July 21, 2000, the
disclosure of which is hereby incorporated by reference in its entirety for all purposes.

BACKGROUND OF THE INVENTION

[02] The present invention generally relates to a system with an account
10 management protocol for wireless devices, and in particular, to a system with an account
management protocol which is used to monitor and track usage and account activities of a
wireless device.

[03] More specifically, the account management system is adapted for a mobile
phone so as to allow the usage and account activities of the mobile phone to be tracked
15 and monitored on an individual basis. A number of accounting systems are described in
U.S. Patent Nos. 5,325,418 (the '418 Patent), 5,625,669 (the '669 Patent), 5,577,100 (the
'100 Patent), and 6198,915 B1 (the '915 Patent), which are incorporated herein by
reference. The '418 and '669 Patents describe accounting systems with features that have
particular application to post-paid mobile phone services, such as a mobile phone rental
20 service or controlled mobile phone services. In a controlled mobile phone service,
capturing phone call data and calculating phone charges for each call enable service
providers (or corporations in an intra-corporate system) to limit, or at least monitor,
mobile phone usage before the periodic billing cycle. For example, if mobile phone
usage exceeds a pre-established limit, the mobile phone could be temporarily disabled or
25 restricted until an interim payment or additional credit sources are obtained. In an intra-
corporate system, a warning message could be sent to a corporate authority that could
then either authorize additional use or temporarily disable the mobile phone. In such
systems, phone call data is stored in the mobile phone and then transmitted to a host
processor that calculates charges. The host processor is typically located on a network
30 that is separate from the mobile phone.

[04] Since the issuance of the '418 and '669 Patents, the state of the art has
advanced to a point where an accounting application in the mobile phone is able to
calculate calling charges internally. As described in the '100 and '915 Patents, such

systems minimize the communication traffic required between the service provider's host processor and the mobile phone and thus expand the overall traffic handling capacity of the mobile phone system. The '100 and '915 Patents describe accounting systems with features that have particular application to pre-paid mobile phone services.

5 [05] Due to the increasing ease of use and lower costs, the proliferation and use of mobile phones is going to continue. Many companies nowadays provide employees with mobile phones in order to ensure that such employees remain in contact. Since carrying two mobile phones is quite impractical, these employees inevitably tend to use their company-provided mobile phones for both business and personal calls. Hence, in
10 order to prevent abuses and/or provide accurate accounting, it would be desirable to have the ability to monitor proper usage and account activities of company-provided mobile phones.

 [06] Furthermore, some mobile phones on the market today provide a two-line or multi-line capability. With a two-line phone, the two phone lines could be dedicated to
15 handle a first type and a second type of calls respectively. As a result, account activities for different types of calls may need to be monitored separately. Therefore, it would be desirable to provide a mobile phone system that is capable of handling and monitoring different types of usage and account activities for wireless devices.

SUMMARY OF THE INVENTION

20 [07] The system of the present invention relates to wireless communication systems having wireless devices, particularly mobile phones, that are part of a wireless communication network. In particular, the present invention relates to a wireless device, such as a mobile phone, that includes an internal account management application for internal management of a variety of accounts. In an exemplary embodiment, the account
25 management application interacts with an accounting application for calculation of communication charges on the fly. Such mobile phones are typically cellular telephones in a cellular phone network, radio telephones in a personal communication service network or other communication system, where the mobile phone is moveable from place to place.

30 [08] Use of the system of the present invention is intended for mobile phones, where real time calculation of calling charges is desirable to limit phone usage or to immediately bill for phone usage where the billings of the public switched service providers and participating wireless service providers are not yet available.

[09] The account management system includes an account management application, carried internally in the wireless device, that manages a variety of accounts. The account management application interacts with one or more accounting applications, such as, a complex billing algorithm with multiple factor accounting protocol to account for local charges, roaming charges when the wireless device moves from one zone to another, long distance charges, international charges including country independent local charges, and surcharges which may be per call or rate based. The complex billing algorithm can be expanded to accommodate special charges of service providers or called stations or special discounts or premiums for data transfer calls.

[10] The accounting applications related to mobile phone usage may include a rate schedule. A rate schedule in the wireless device may be periodically updated by wireless communications with the service provider's host processor or customer service representative. The accounting applications related to m-commerce transactions obtain the amount to be deducted from a pre-defined communication protocol with the vendor's transaction device or customer service representative.

[11] It is to be understood that the accounting applications may reside either in the wireless device or on a network which is accessible to the wireless device. Depending on design specification or constraints, the functionality of the account management application may be incorporate into the accounting application.

[12] It is to be further understood that the wireless device with the account management system can be implemented into existing wireless communication networks without substantial modification to the network and can be implemented into most existing wireless devices with minimal modification, primarily by internal reprogramming of the wireless device. Modification to most existing wireless devices is even more minimal when existing accounting applications residing on a network are utilized by the wireless device.

[13] A wireless device such as a mobile phone currently includes an internal processor and sufficient internal memory to incorporate the programming and data storage necessary to accomplish the real time accounting. The account management application and the complex algorithms providing the multiple factor accounting capabilities are sufficiently compact that storage and processing of the call data is enabled in real time with sufficient accuracy to account for multiple charges from multiple service providers even for a roaming phone. The accounting and account management

applications should utilize an encryption system to permit secure programming and transactions over the airways.

[14] The accounting and account management system as described herein provides customers and businesses with greater flexibility in managing costs of mobile phone use and m-commerce transactions, especially where costs must be segregated into different accounts by multiple criteria such as business versus personal, or by different profit centers within the same business. The increased flexibility also includes different methods for controlling costs with respect to each account such as pre-paid service or post-paid service with usage limits. The present invention describes a system in which an individual wireless device could be utilized in a controlled service mode for certain purposes such as business calls, in a pre-paid service mode for other purposes such as private calls, and have additional secure electronic accounts for other m-commerce transactions.

[15] The system of the present invention is adapted for analog or digital cellular telephones, radiophones in personal communication service networks and other wireless communication systems. The system is also adapted for other wireless devices, such as personal digital assistants, that are used for m-commerce transactions through short-range radio frequency communication protocols or data bearer communication services such as short message service.

[16] Reference to the remaining portions of the specification, including the drawings and claims, will realize other features and advantages of the present invention. Further features and advantages of the present invention, as well as the structure and operation of various embodiments of the present invention, are described in detail below with respect to accompanying drawings, like reference numbers indicate identical or functionally similar elements.

BRIEF DESCRIPTION OF THE DRAWINGS

[17] Fig. 1 is a simplified schematic diagram illustrating a typical wireless telecommunication arrangement;

[18] Fig. 2 is a simplified schematic diagram illustrating a typical arrangement for sending data bearer messages such as short message service to a wireless device;

[19] Fig. 3 is a simplified schematic diagram illustrating a typical wireless transaction arrangement; and

[20] Fig. 4 is a simplified schematic diagram showing an exemplary embodiment of a wireless device in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[21] Fig. 1 is a simplified schematic diagram illustrating a typical wireless telecommunication arrangement. A network 10 communicates with a wireless device 14, such as a mobile phone, via a transmission station 12. The transmission station 12 uses over-the-air communications to communicate with the wireless device 14. Over-the-air communication protocols which can be used to implement wireless communications between the wireless device 14 and the network 10 include, for example, GSM, CDMA, TDMA, UMTS, etc. A person of ordinary skill in the art will know of other ways and methods to implement over-the-air communications.

[22] Fig. 2 is a simplified schematic diagram illustrating a typical arrangement for sending data bearer messages such as short message service to a wireless device 14. An application program 16 residing on a host processor 18 uses a communication link 20, such as a TCP/IP link over the Internet, to communicate with a data bearer message controller 22 within the network 10 to transmit a data bearer message such as a short message service message to the wireless device 14, such as a mobile phone, via a transmission station 12.

[01] Fig. 3 is a simplified schematic diagram illustrating a typical wireless transaction arrangement. A vending machine 24 with a short range radio communication transceiver and the wireless device 14, such as a mobile phone with a short range radio communication transceiver, communicate using a short range radio communication link 26. Short range radio communication links which can be used to implement wireless communications between the wireless device 14 and the vending machine 24 include, for example, Bluetooth™ wireless communication links. A person of ordinary skill in the art will know of other ways and methods to communicate transactional data between two devices. As another example, vending machine 24 and wireless device 14, each with the appropriate transceiver, can communicate transactional data using a data bearer message service such as short message service.

[24] Referring to Fig. 4, there is shown an exemplary embodiment of the wireless device 14 in accordance with the present invention. According to the exemplary embodiment, the wireless device 14 includes an account management application 30 which permits the usage and account activities of the wireless device 14 to be tracked and

monitored on an individual basis. The account management application 30 functions as multiple virtual wallets and is capable of maintaining a number of different accounts which are chargeable for calls or transactions handled by the wireless device 14. The different accounts include, for example, traditional postpaid account, postpaid monitored
5 or controlled usage account, and prepaid account.

[25] The account management application 30 can reside on executable memory within the wireless device 14. Such memory can be one of any type such as ROM, EPROM, or flash memory. The account management application 30 can store dynamic data in RAM and utilize nonvolatile memory such as EEPROM or flash memory to store
10 control data. Alternatively, the account management application 30 can reside on a smart card, such as a universal subscriber identification module (USIM) or Universal Identity Module (UIM), which is attachable to the wireless device 14.

[26] According to an exemplary embodiment, the account management application 30 further interacts with other applications, such as the accounting application
15 32 described below, so as to properly manage and process the different accounts. The accounting application 32 is capable of calculating calling charges in real time or on the fly. An example of the accounting application 32 is the complex billing algorithm described in the '100 Patent. The complex billing algorithm factors the multiple variables of a telephone call from a mobile phone into a billing equation that virtually mirrors the
20 factors considered by public switched network providers and participating wireless service providers, (of which there may be more than one in a single call). The resultant call charge accurately approximates the summation of real charges that will be billed by the participating service providers thereby enabling an instantaneous calculation and display of calling charges. The complex billing algorithm can be expanded to
25 accommodate special charges of service providers or called stations or special discounts or premiums for data transfer calls. The accounting application 32 can reside on executable memory within the wireless device 14. Such memory can be one of any type such as ROM, EPROM, or flash memory. The accounting application 32 can store dynamic data in RAM and utilize nonvolatile memory such as EEPROM or flash memory
30 to store control data. Alternatively, the accounting application 32 can reside on a smart card, such as a universal subscriber identification module (USIM) or Universal Identity Module (UIM), which is attachable to the wireless device 14. In the alternative, it is to be also understood that the accounting application 32 may reside on the network 10. A

person of ordinary skill in the art will know of ways and methods to obtain and retrieve calling charge information from an accounting application 32 residing on the network 10.

[27] It is to be further understood that the accounting applications 32 may reside either in the wireless device 14 or on the network 10 which is accessible to the wireless device 14. Depending on design specification or constraints, the functionality of the account management application 30 may be incorporated into or combined with the accounting application 32.

[28] The wireless device 14 can be programmed using systems such as that described in U.S. Patent No. 6,243,574 B1. In addition to installing account management application 30 and accounting applications 32, programming can include providing data, such as initial monetary values for pre-paid accounts or credit limits, to the wireless device 14. Alternatively, the wireless device 14 can be programmed over the air using DTMF signals, or a data bearer communication service such as short message service, initiated from an application program 16 residing on a host processor 18 such as described in the '100 Patent.

[29] The wireless device 14 is preferably a contemporary unit with an LCD display screen for display of numeric or alphanumeric data, such as a user menu and warning messages; a keypad for entry of data, such as menu selections; and a timer for determining the duration of calls thereby allowing calling charges to be calculated. In the alternative, a person of ordinary skill in the art will know that timer information can be obtained from the network 10.

[30] In an exemplary embodiment, the account management application 30 charges a call or transaction to the account selected by a user. The account selection is accomplished via a user interface. The user interface permits the user to interact with the account management application 30 and select which one of the accounts is to be used for each call or transaction. Furthermore, the user interface also allows the user to perform certain account management functions. For example, the user, via the user interface, may transfer balances between accounts or perform other typical accounting functions. As another example, the user, via the user interface, may change the account to which a particular call has been charged. Preferably, the user interface is implemented in the form of a menu of available accounts presented on the LCD screen of the wireless device 14.

[31] In an exemplary mode of operation, the usage and account activities of the wireless device 14 are monitored and tracked as follows. In the situation where an outgoing call is to be made via the wireless device 14, before such call is made, the user

using the user interface selects which account is to be charged for that call. Once the account is selected, the user then continues with the normal procedures to make the call. If, for example, a prepaid account is selected, the accounting application 32 then calculates the charges to be debited and the account management application 30 accordingly debits the selected prepaid account.

[32] Similarly, in the situation where an incoming call is to be received by the wireless device 14, before such call is answered, the user using the user interface selects which account is to be charged for that call. Once the account is selected, the user then continues with the normal procedures to receive the call. If, for example, a postpaid account is selected, the charges for the call are calculated and the account management application 30 accordingly updates the postpaid account.

[33] As described above, a selected account is charged for a call handled by the wireless device 14. However, it should be understood that an account may also be charged for any transaction handled by the wireless device 14. That is, the account management application 30 is also able to monitor and track transactions handled by the wireless device 14. For example, referring to Fig. 3, if the wireless device 14 is used to communicate with the vending machine 24 to make a purchase, an appropriate account on the wireless device 14 can similarly be charged for making that purchase.

[34] Alternatively, the account management application 30 may automatically select the account to be charged from a multifactor algorithm. For example, where the wireless device 14 is a multi-line mobile phone, the account management application 30 detects which line of the multi-line mobile phone is in use and charges the account associated with that line. The calling charges to be applied to that account is determined by the accounting application 32. For example, the account management application 30 may select and apply a postpaid account for calls made or received on one line and select and apply a prepaid account for calls made or received on another line.

[35] In another exemplary embodiment, the account management application 30 is able to determine the telephone number of the device which originated the call using the network 10 automatic number identification features, and charge the account associated with that telephone number in a table stored on EEPROM or flash memory within the wireless device 14. In the event that the originating telephone number was not found in the table, a default account is then charged or the user is prompted to select an account to be charged for the call. The timing of the prompt may vary depending on design. For example, the prompt may occur after the call is concluded, if the available

prepaid fund and/or credit limit of all potentially chargeable accounts was sufficient.

Alternatively, the timing of the prompt may also occur at the preprogrammed time for warning of exhaustion of the available prepaid fund and/or credit limit based on the account, out of all potentially chargeable accounts, which first reaches the time for such
5 warning. It is understood that the multifactor algorithm may include one or more of the above factors, as well as other factors appropriate for selecting the account to be charged.

[36] In an exemplary embodiment, the account management application 30 maintains each account according to an algorithm programmed by the service provider or by authorized corporate personnel. For example, an application program 16 residing on a
10 host processor 18 can provide secure access to authorized corporate personnel to allow such personnel to enter control data with respect to each account. The application program 16 can initiate the transmission of a data bearer message, such as a short message service message, which, when received by the wireless device 14, accordingly reprograms the wireless device 14 with such control data. For example, one account may
15 be set up to be a traditional postpaid account with a limit on usage and a second account may be set up to be a prepaid account. Corporate procedures may require the user to use the first account only for legitimate business calls. The user's compliance with such procedures may be monitored through call detail records stored on the wireless device 14 and transmitted to a host processor as described in the '418 and '669 Patents.

20 [37] It is understood that the call detail records can be stored on RAM or other memory within the wireless device 14, or alternatively, the call detail records can be stored on a smart card, such as a universal subscriber identification module (USIM), which is attachable to the wireless device 14.

[38] The control data transmitted to the wireless device 14 can also be used to
25 determine the consequence of the user reaching a usage limit. For example, one such consequence is for the account management application 30 to generate and transmit an SMS message, or other data bearer message, to the appropriate corporate authority warning that the user had exceeded the usage limit and that review of the call detail records is warranted. Another such consequence is for the account management
30 application 30 to temporarily restrict operation of the wireless device 14, allowing only emergency calls and calls to customer representatives until the restriction is removed. Corporate procedures may permit personal calls on the same wireless device 14 if the user utilizes the second account, the prepaid account. Authorized corporate personnel may receive acceptable forms of payment from the user, and, using the application program

16, transmit control data to the wireless device 14 adding funds to the prepaid account accordingly, similar to the description in the '100 Patent.

[39] In another exemplary embodiment, an application program 16 on a host processor 18 is able to provide secure access to authorized personnel of a service provider or, in an intra-corporate system, of the corporation to change control data with respect to each account. The application program 16 can initiate the transmission of a data bearer message, such as a short message service message, which, when received by the wireless device 14, accordingly reprograms the wireless device 14 with such control data. Examples of such changes include changes in the rate tables utilized by the accounting application 32, changes in credit limits for controlled post-paid accounts, and changes in paid funds in pre-paid accounts etc. Alternatively, the users may be provided with over the air access to application program 16 on the host processor 18 to make limited changes, such as using credit cards or prepaid calling cards to add funds to pre-paid accounts, similar to the description provided in the '100 Patent. Furthermore, the updated rate table may be transmitted to the wireless device 14 when the user applies for an increase in the internal phone account.

[40] In an exemplary embodiment, the account management application 30 is able to generate audio warnings through the speaker of the wireless device 14 and/or warning messages displayed on the LCD screen of the wireless device 14 so as to inform the user that s/he is about to exhaust the credit limit or prepaid funds. The warning messages may include information identifying the applicable account and the amount of remaining funds or credit.

[41] The system of the present invention provides substantial flexibility by the features described above. For example, a user of the wireless device 14 is given the flexibility to pay for each call differently on an ad hoc basis. A user may wish to separate and pay for the calls based on the nature of each call. Business and personal calls handled by the same wireless device 14 may be paid from different accounts. A business call is to be paid from one account and a personal call is to be paid from another account. A user may also wish to use different accounts to pay for different calls; one call may be paid from a prepaid account, while another call may be charged to a postpaid account.

[42] It is understood that the examples and embodiments described herein are for illustrative purposes only and that various modifications or changes in light thereof will be suggested to persons skilled in the art and are to be included within the spirit and purview of this application and scope of the appended claims. All publications, patents,

and patent applications cited herein are hereby incorporated by reference for all purposes in their entirety.

WHAT IS CLAIMED IS:

- 1 1. A system for handling a plurality of account activities, comprising:
2 a wireless device capable of performing a plurality of billable operations;
3 an account management application residing in the wireless device;
4 wherein the account management application is configured to manage a
5 plurality of accounts; and
6 wherein each billable operation performed by the wireless device is
7 selectively charged to one of the plurality of accounts.
- 1 2. The system according to claim 1 further comprising:
2 a user interface configured to allow a user to determine how each billable
3 operation performed by the wireless device is to be selectively charged to one of the
4 plurality of accounts.
- 1 3. The system according to claim 1 wherein the account management
2 application automatically selects one of the plurality of accounts to be charged for at least
3 one of the plurality of billable operations in accordance with an algorithm.
- 1 4. The system according to claim 1 further comprising:
2 an accounting application configured to calculate charges for each billable
3 operation performed by the wireless device;
4 wherein the account management application functions in cooperation with
5 the accounting application to manage the plurality of accounts.
- 1 5. The system according to claim 1 wherein the plurality of billable
2 operations includes making or receiving a voice or data communication.
- 1 6. The system according to claim 5 wherein how each billable
2 operation performed by the wireless device is to be selectively charged to one of the
3 plurality of accounts depends on origin or destination of the voice or data communication.
- 1 7. The system according to claim 1 wherein the wireless device is a
2 mobile phone.
- 1 8. The system according to claim 1 wherein the account management
2 application resides on a smart card attachable to the wireless device.

1 9. The system according to claim 1 wherein the account management
2 application resides on a memory residing in the wireless device.

1 10. The system according to claim 1 wherein the accounting
2 application resides on a memory residing in the wireless device.

1 11. The system according to claim 1 wherein the accounting
2 application resides on a network.

1 12. The system according to claim 1 wherein the account management
2 application is configured so as to allow a user to transfer balances amongst the plurality
3 of accounts.

1 13. The system according to claim 1 wherein the plurality of accounts
2 includes a postpaid account and a prepaid account.

1 14. The system according to claim 1 wherein at least one of the
2 plurality of accounts has a usage limit; and
3 wherein the plurality of billable operations performable by the wireless
4 device is restricted when the usage limit is exceeded.

1 15. A wireless device configured to perform a plurality of billable
2 operations, comprising:
3 an account management application residing on the wireless device and
4 configured to maintain a plurality of accounts;
5 an accounting application configured to calculate charges for each billable
6 operation performed by the wireless device; and
7 a user interface configured to allow a user to selectively determine how
8 each billable operation performed by the wireless device is to be charged to one of the
9 plurality of accounts;
10 wherein the account management application and the accounting
11 application function in cooperation with each other in order to maintain the plurality of
12 accounts.

1 16. The wireless device of claim 15 wherein the plurality of billable
2 operations includes making or receiving a voice or data communication.

1 17. The wireless device of claim 16 wherein how each billable
2 operation performed by the wireless device is to be selectively charged to one of the
3 plurality of accounts depends on origin or destination of the voice or data communication.

1 18. The wireless device of claim 15 wherein the wireless device is a
2 mobile phone.

1 19. The wireless device of claim 15 wherein the account management
2 application resides on a smart card attached to the wireless device.

1 20. The wireless device of claim 15 wherein the account management
2 application resides on a memory residing in the wireless device.

1 21. The wireless device of claim 15 wherein the accounting application
2 resides on a network.

1 22. The wireless device of claim 15 wherein the account management
2 application is configured so as to allow the user to transfer balances amongst the plurality
3 of accounts.

1 23. The wireless device of claim 14 wherein the plurality of accounts
2 includes a postpaid account and a prepaid account.

1 24. The wireless device of claim 14 wherein at least one of the
2 plurality of accounts has a usage limit; and
3 wherein the plurality of billable operations performable by the wireless
4 device is restricted when the usage limit is exceeded.

1 25. A mobile phone comprising:
2 a first line and a second line both configured to make and receive calls;
3 and
4 an account management application residing on the mobile phone and
5 configured to manage a plurality of accounts;
6 wherein calls made or received via the first line is charged to one of the
7 plurality of accounts and calls made or received via the second line is charged to another
8 one of the plurality of accounts.

1 26. The mobile phone of claim 25 further comprising:
2 a user interface configured to allow a user to selectively determine how
3 each call made or received by the mobile phone is to be charged to one of the plurality of
4 accounts.

1 27. The mobile phone of claim 25 further comprising:
2 an accounting application configured to calculate charges for each call
3 made or received by the mobile phone.

1 28. The mobile phone of claim 25 wherein the account management
2 application resides on a smart card attachable to the mobile phone.

1 29. The mobile phone of claim 25 wherein the account management
2 application resides on a memory residing in the mobile phone.

1 30. The mobile phone of claim 27 wherein the accounting application
2 resides on a memory residing in the mobile phone.

1 31. The mobile phone of claim 27 wherein the accounting application
2 resides on a network.

1 32. The mobile phone of claim 25 wherein the plurality of accounts
2 includes a postpaid account and a prepaid account.

1 33. The mobile phone of claim 25 wherein the calls made or received
2 via the first line include business calls and the calls made or received via the second line
3 include personal calls.

1 34. The mobile phone of claim 25 wherein the account management
2 application is configured so as to allow the user to transfer balances amongst the plurality
3 of accounts.

1 35. A method for tracking account activities relating to a plurality of
2 billable operations performable by a wireless device, comprising:
3 selecting one of a plurality of accounts to be charged for a billable
4 operation, wherein the plurality of accounts are maintained on the wireless device;
5 calculating charges to be paid for the billable operation;

6 causing the wireless device to perform the billable operation; and
7 updating the selected account.

1 36. The method according to claim 35 wherein the step of selecting
2 one of the plurality of accounts further comprises:
3 allowing a user to select one of the plurality of accounts via a user
4 interface.

1 37. The method according to claim 35 wherein the step of calculating
2 charges to be paid for the billable operation is performed by an accounting application.

1 38. The method according to claim 35 wherein the accounting
2 application resides on a memory residing in the wireless device.

1 39. The method according to claim 35 wherein the accounting
2 application resides on a network.

1 40. The method according to claim 35 wherein the wireless device is a
2 mobile phone.

1 41. The method according to claim 35 wherein the billable operation
2 includes making or receiving a voice or data communication.

1 42. The method according to claim 41 wherein the step of selecting
2 one of a plurality of accounts to be charged for the billable operation further comprises:
3 identifying origin or destination of the voice or data communication;
4 selecting the one of the plurality of accounts to be charged for the billable
5 operation based on the identified origin or destination of the voice or data
6 communication.

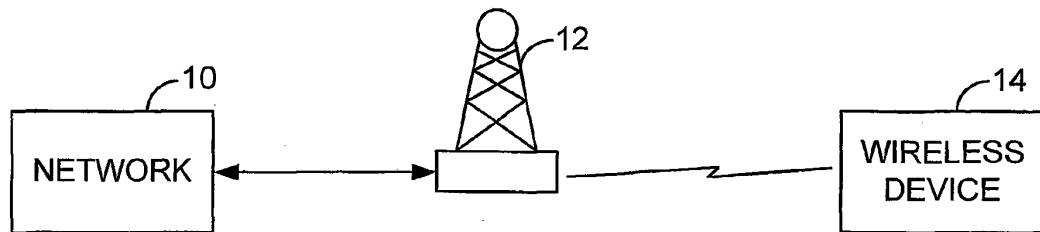
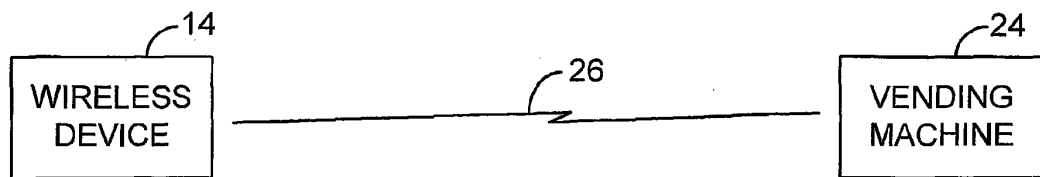
1 43. The method according to claim 35 further comprising:
2 restricting ability of the wireless device to perform the billable operation
3 when credit limit of at least one of the plurality of accounts is exceeded.

1 44. The method according to claim 35 further comprising:

2 restricting ability of the wireless device to perform the billable operation
3 when prepaid level of at least one of the plurality of accounts is exhausted or goes below
4 a pre-established limit.

1 45. A method for tracking account activities made by a mobile phone
2 having a first line and a second line both configured to make and receive calls,
3 comprising:
4 assigning a first account to calls made or received via the first line;
5 assigning a second account to calls made or received via the second line,
6 wherein the first and second accounts are maintained on the mobile phone;
7 making or receiving a call via either the first line or the second line;
8 calculating charges to be paid for the call; and
9 updating either the first account or the second account based on the
10 calculated charges depending on which one of the first and second lines the call is made
11 or received.

1/3

**FIG. 1.****FIG. 3.**

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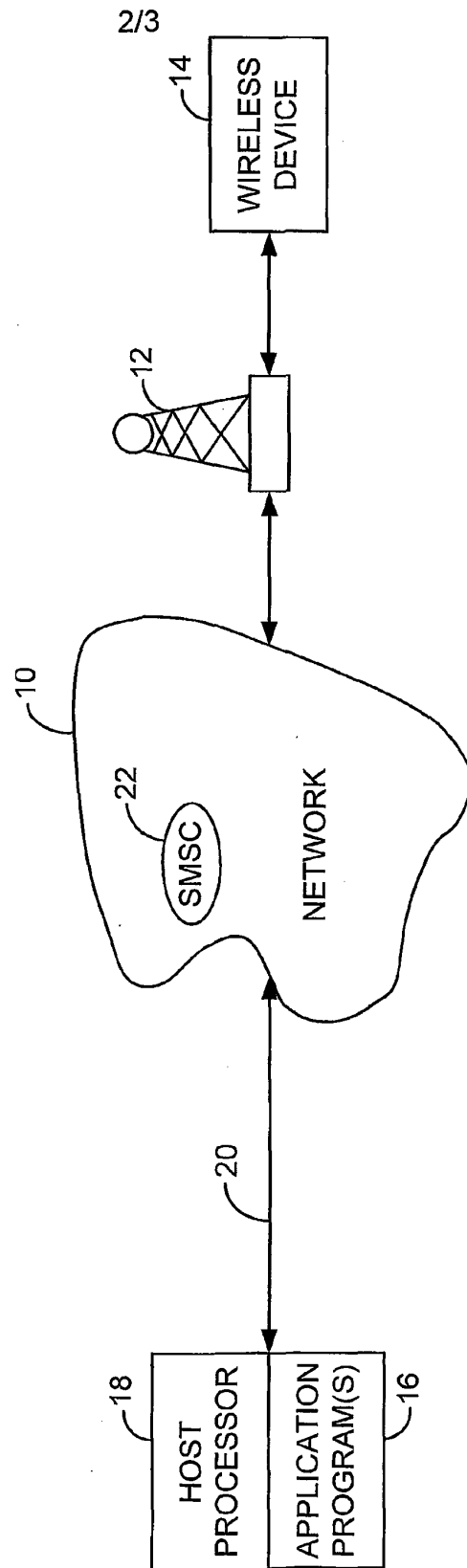


FIG. 2.

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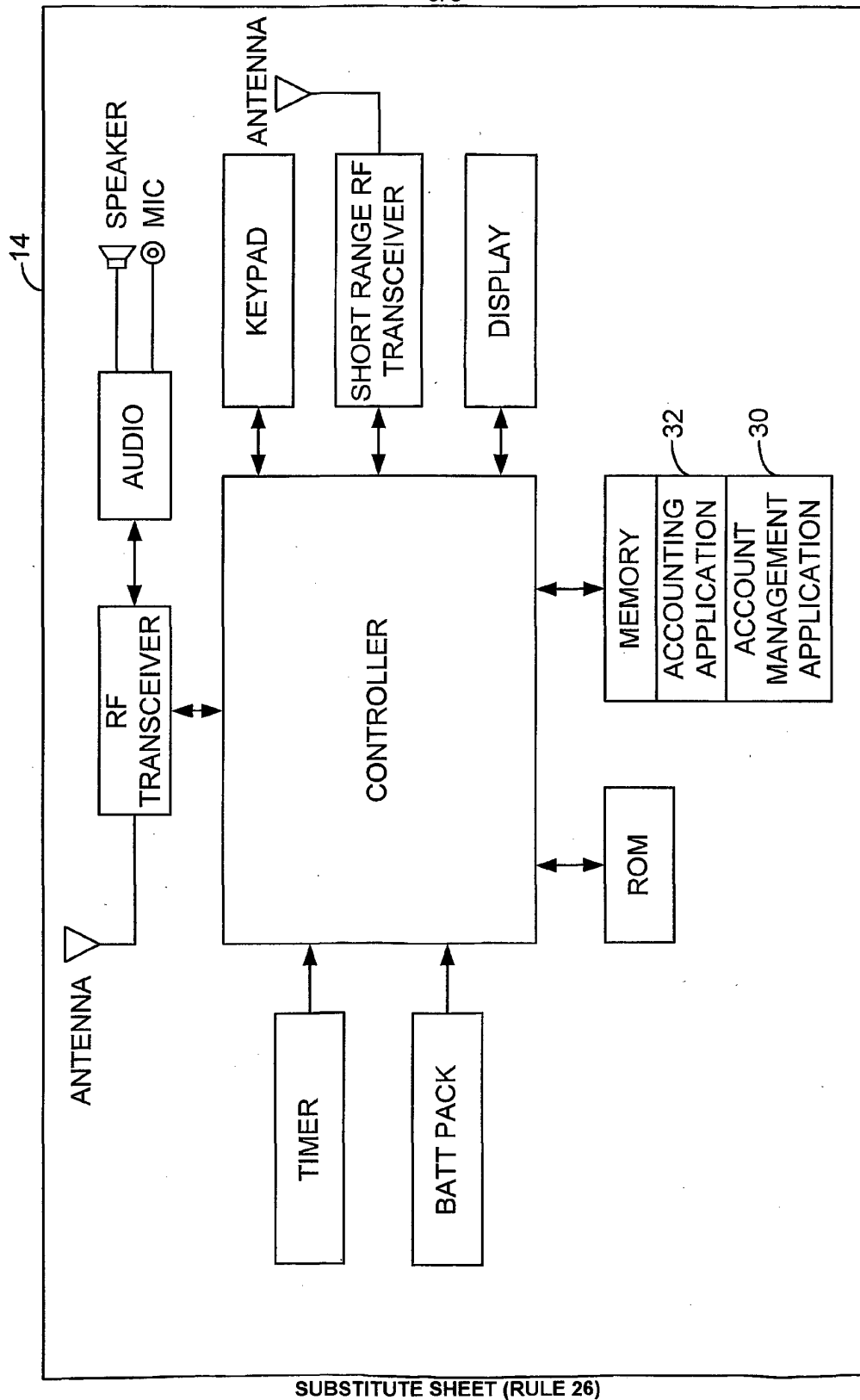


FIG. 4.

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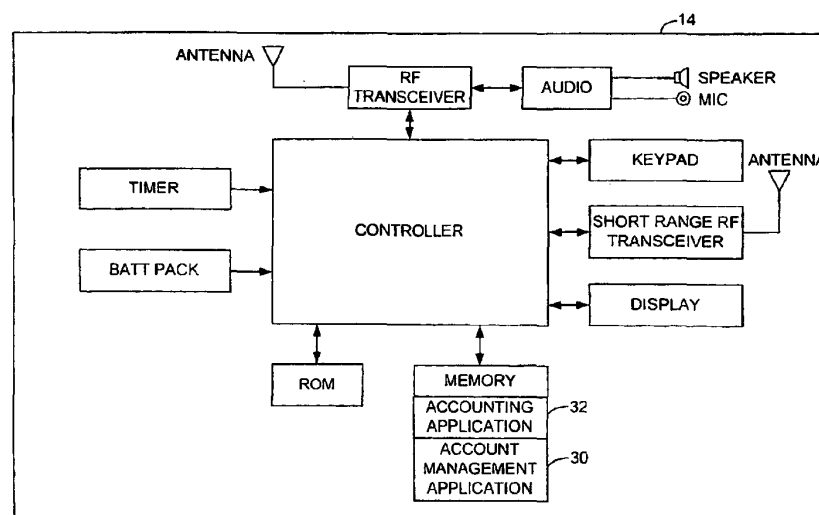
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(54) Title: **MULTIPLE VIRTUAL WALLETS IN WIRELESS DEVICES**



(57) Abstract: A system having a wireless device (14) capable of monitoring and tracking its own usage and account activities is disclosed. The wireless device (14) includes an account management application (30) and accounting applications (32). The account management application (30) manages a variety of accounts in conjunction with the accounting applications (32) and is used by a user to determine how each call/transaction is to be paid for. For example, the user of the wireless device (14) may wish to pay for business calls using a first account and personal calls using a second account.



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

INTERNATIONAL SEARCH REPORT

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B. FIELDS SEARCHED

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EAST**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,774,533 A (PATEL) 30 June 1998 (30.06.1998), column 7, lines 8-31, column 17, line 57 - column 18, line 19, and figure 3.	1-45
Y	US 5,956,653 A (LAHTI) 21 September 1999 (21.09.1999), column 2, lines 7-38, and figure 1.	1-45
Y	US 5,428,666 A (FYFE et al) 27 June 1995 (27.06.1995), column 3, line 59 - column 7, line 36, and figures 1-2.	1-45
Y	US 5,109,401 A (HATTORI et al) 28 April 1992 (28.04.1992), see abstract, column 5, line 56 - column 6, line 56, and figure 3.	14, 24, 43, 44
A	US 5,657,373 A (HERMANSSON et al) 12 August 1997 (12.08.1997), column 4, line 2 - column 5, line 2.	1-45

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

* Special categories of cited documents:

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document member of the same patent family

Date of the actual completion of the international search

17 September 2001 (17.09.2001)

Date of mailing of the international search report

22 JAN 2002

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Quochien Vuong

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Form PCT/ISA/210 (second sheet) (July 1998)

Electronic Acknowledgement Receipt	
EFS ID:	30055075
Application Number:	15369542
International Application Number:	
Confirmation Number:	6887
Title of Invention:	System and Method for Wireless Network Offloading
First Named Inventor/Applicant Name:	Gregory G. Raleigh
Customer Number:	106963
Filer:	James E. Harris/Ann Taylor
Filer Authorized By:	James E. Harris
Attorney Docket Number:	RALEP049D1C1
Receipt Date:	11-AUG-2017
Filing Date:	05-DEC-2016
Time Stamp:	13:36:19
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	P049D1C1_IDS.pdf	1054582 e2daf3519437a00a102d3bb331dfce88ab765ccc	no	6

Warnings:

Information:					
2	Foreign Reference	2094.pdf	3952944	no	25
			dfa7cbac15ff6f3701105acf137953f96f215840		
Warnings:					
Information:					
Total Files Size (in bytes):				5007526	
<p>This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.</p> <p><u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.</p> <p><u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.</p> <p><u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.</p>					

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		15369542
	Filing Date		2016-12-05
	First Named Inventor	Gregory G. Raleigh	
	Art Unit	2464	
	Examiner Name	Ngo, Ricky Quoc	
	Attorney Docket Number	RALEP049D1C1	

U.S.PATENTS						Remove
Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1	6760417	B1	2004-07-06	Wallenius, Jukka	
	2	7539862	B2	2009-05-26	Edgett et al.	
	3	7721296	B2	2010-05-18	Ricagni, Giuseppe	
	4	7873346	B2	2011-01-18	Petersson et al.	
	5	7873540	B2	2011-01-18	Arumugam, Avin	
	6	8091087	B2	2012-01-03	Ali et al.	
	7	8146142	B2	2012-03-27	Lortz et al.	
	8	8190087	B2	2012-05-29	Fisher et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		15369542
	Filing Date		2016-12-05
	First Named Inventor	Gregory G. Raleigh	
	Art Unit	2464	
	Examiner Name	Ngo, Ricky Quoc	
	Attorney Docket Number	RALEP049D1C1	

	9	8214890	B2	2012-07-03	Kirovski et al.	
	10	8285992	B2	2012-10-09	Mathur et al.	
	11	8588240	B2	2013-11-19	Ramankutty et al.	
	12	8676682	B2	2014-03-18	Kalliola, Janne	
	13	8818394	B2	2014-08-26	Bienas et al.	
	14	9064275	B1	2015-06-23	Lu et al.	
	15	9286604	B2	2016-03-15	Aabye et al.	
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Examiner Initial*	Cite No	Publication Number	Kind Code ¹	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1	20100284388	A1	2010-11-11	Fantini et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		15369542	
	Filing Date		2016-12-05	
	First Named Inventor	Gregory G. Raleigh		
	Art Unit	2464		
	Examiner Name	Ngo, Ricky Quoc		
	Attorney Docket Number	RALEP049D1C1		

	2	20110252430	A1	2011-10-13	Chapman et al.	
	3	20020099848	A1	2002-07-25	Lee, Hoon	

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FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Number ³	Country Code ² i	Kind Code ⁴	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear	T ⁵
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NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T ⁵
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Examiner Signature		Date Considered	
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¹ See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. ² Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁵ Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		15369542
	Filing Date		2016-12-05
	First Named Inventor	Gregory G. Raleigh	
	Art Unit	2464	
	Examiner Name	Ngo, Ricky Quoc	
	Attorney Docket Number	RALEP049D1C1	

CERTIFICATION STATEMENT			
Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):			
<p>That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).</p>			
OR			
<p>That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).</p>			
☐ See attached certification statement. The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.			
☒ A certification statement is not submitted herewith.			
SIGNATURE			
A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.			
Signature	/James E. Harris/	Date (YYYY-MM-DD)	2017-11-09
Name/Print	James E. Harris	Registration Number	40013
<p>This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.</p>			

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The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt	
EFS ID:	30907396
Application Number:	15369542
International Application Number:	
Confirmation Number:	6887
Title of Invention:	System and Method for Wireless Network Offloading
First Named Inventor/Applicant Name:	Gregory G. Raleigh
Customer Number:	106963
Filer:	James E. Harris/Ann Taylor
Filer Authorized By:	James E. Harris
Attorney Docket Number:	RALEP049D1C1
Receipt Date:	09-NOV-2017
Filing Date:	05-DEC-2016
Time Stamp:	16:31:09
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	P049D1C1.pdf	1054428 71113177c8ee6be5fc55cb8658c9cea685551d3f	no	5

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Total Files Size (in bytes):	1054428
<p>This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.</p> <p><u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.</p> <p><u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.</p> <p><u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.</p>	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		15369542
	Filing Date		2016-12-05
	First Named Inventor	Gregory G. Raleigh	
	Art Unit	2464	
	Examiner Name	Ngo, Ricky Quoc	
	Attorney Docket Number	RALEP049D1C1	

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Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1	7165040	B2	2007-01-16	Ehrman et al.	
	2	7656271	B2	2010-02-02	Ehrman et al.	
	3	8401968	B1	2013-03-19	Schattauer et al.	
	4	6535949	B1	2003-03-18	Parker, Kenneth W.	
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Examiner Initial*	Cite No	Publication Number	Kind Code ¹	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1	20060101507	A1	2006-05-11	Camenisch, Ja L.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		15369542
	Filing Date		2016-12-05
	First Named Inventor	Gregory G. Raleigh	
	Art Unit	2464	
	Examiner Name	Ngo, Ricky Quoc	
	Attorney Docket Number	RALEP049D1C1	

	2	20070171856	A1	2007-07-26	Bruce et al.	
	3	20110004917	A1	2011-01-06	Saisa et al.	

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Examiner Initial*	Cite No	Foreign Document Number ³	Country Code ² i	Kind Code ⁴	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear	T ⁵
	1	1098490	EP	A2	2001-05-09	Nortel Networks Ltd.		
	2	2026514	EP	A1	2009-02-18	Nokia Siemens Networks		
	3	2007129180	WO	A2	2007-11-15	Nokia Corp.		
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		15369542
	Filing Date		2016-12-05
	First Named Inventor	Gregory G. Raleigh	
	Art Unit	2464	
	Examiner Name	Ngo, Ricky Quoc	
	Attorney Docket Number	RALEP049D1C1	

EXAMINER SIGNATURE			
Examiner Signature		Date Considered	
<p>*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.</p>			
<p><small>¹ See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. ² Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁵ Applicant is to place a check mark here if English language translation is attached.</small></p>			

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	Filing Date		2016-12-05
	First Named Inventor	Gregory G. Raleigh	
	Art Unit	2464	
	Examiner Name	Ngo, Ricky Quoc	
	Attorney Docket Number	RALEP049D1C1	

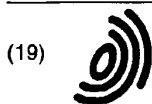
CERTIFICATION STATEMENT			
Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):			
<p>That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).</p>			
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☐ See attached certification statement. The fee set forth in 37 CFR 1.17 (p) has been submitted herewith. ☒ A certification statement is not submitted herewith.			
SIGNATURE			
A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.			
Signature	/James E. Harris/	Date (YYYY-MM-DD)	2018-02-08
Name/Print	James E. Harris	Registration Number	40013
<p>This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.</p>			

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5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
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(11)

EP 1 098 490 A2

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
09.05.2001 Bulletin 2001/19

(51) Int Cl.7: H04L 29/06

(21) Application number: 00309735.9

(22) Date of filing: 03.11.2000

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE TR
Designated Extension States:
AL LT LV MK RO SI

- Hanley, Donald V.
McKinney, Texas 75075 (US)
- Morrow, Glenn C.
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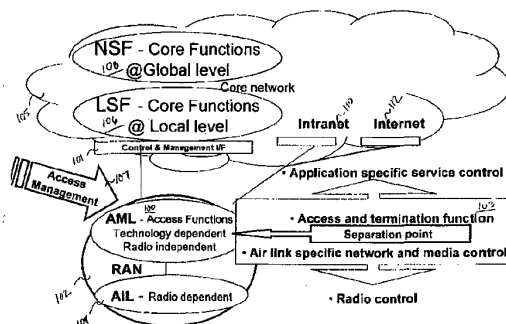


(54) An architecture for an IP centric distributed network

(57) A method and system to for a communications network architecture for an Internet Protocol centric wireless network for a first user to communicate to a destination, the architecture comprising: a network service function layer within the wireless network. The network service function layer can include: a policy management server; an authorization server; a service accounting server; an authentication, authorization and accounting server; an unified directory within a directory server; a security gateway; and a mobility manager. The architecture also includes a local service function layer associated with the network service function layer. The local service function layer can include: an access accounting server; an authentication, authorization and

accounting server; a security gateway; a policy enforcement server; a mobility manager; a network management server; and a wireless gateway. The architecture also includes an access management layer associated with the local service function layer. The access management layer can include: a location tracking server; a connection management server; a protocol server; an access management server; a policy enforcement server; a network management server; and a resource management server. The architecture also includes an access interface layer associated with the access management layer. The access interface layer can include: a channel management server; a policy enforcement server; an administration and maintenance server; and a radio frequency server.

FIGURE 1



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Description**FIELD OF THE INVENTION**

- 5 [0001] The invention relates generally to computers and, more particularly, to an architecture for an Internet Protocol centric distributed network and a method and apparatus for such a network.

BACKGROUND OF THE INVENTION

- 10 [0002] Recently, wireless communication devices have become more and more popular as a method of communicating from one point to another. Cellular Radio is one, and probably the most popular, method of wireless communication. The original and still, most common Cellular Mobile Telephone System is a low-powered, duplex, radio/telephone which operates between 800 and 900 MHz for TDMA and 1800 and 1900 MHz for CDMA, using multiple transceiver sites linked up to a central computer for coordination. The geographic region served by a cellular system is subdivided into areas called cells. Each cell has a central base station and two sets of assigned transmission frequencies; one set is used by the base station, and the other by mobile telephones. To prevent radio interference, each cell uses frequencies different from those used by its surrounding cells, but cells sufficiently distant from each other can use the same frequencies. When a mobile telephone leaves one cell and enters another, the telephone call is transferred from one base station and set of transmission frequencies to the next using a computerized switching system. The first cellular telephone system began operation in Tokyo in 1979, and the first U.S. system began operation in 1983 in Chicago.

- 20 [0003] The earlier system have been focused on providing mostly voice services with some capability of providing data communications as well. However, recently, the need for a network designed with other services in mind other than just voice has arisen. The network should be able to provide access to different application layer protocols such as Session Initiation Protocol, H.323, and Internet Protocol to name a few.

SUMMARY OF THE INVENTION

- 30 [0004] In contrast to the prior art, the present invention provides a distributed IP centric system and method for wireless access to an internet protocol (IP) based network, wherein the system and method is independent from technology used in accessing the network. The system also uses the application layer to send messages between the access layer and the IP network. The access layer also includes distributed IP based functionality and the flexibility to be incorporated into distributed servers on a Local Area Network (LAN). The access layer also includes the capability to support establishing and maintaining the wireless link and mobility services to the mobile station through the access layers along with simultaneous IP access to public domain services. The access layer also handles connection management independent from the hardware used (such as ATM, Ethernet, etc.).

- 35 [0005] To this end, in one embodiment the method and system include a communications network architecture for an Internet Protocol centric wireless network for a first user to communicate to a destination, the architecture comprising: a network service function layer within the wireless network. The network service function layer can include: a policy management server; an authorization server; a service accounting server; an authentication, authorization and accounting server; an unified directory within a directory server; a security gateway; and a mobility manager. The architecture also includes a local service function layer associated with the network service function layer. The local service function layer can include: an access accounting server; an authentication, authorization and accounting server; a security gateway; a policy enforcement server; a mobility manager; a network management server; and a wireless access gateway. The architecture also includes an access management layer associated with the local service function layer. The access management layer can include: a location tracking server; a connection management server; a protocol server; an access management server; a policy enforcement server; a network management server; and a resource management server. The architecture also includes an access interface layer associated with the access management layer. The access interface layer can include: a channel management server; a policy enforcement server; an administration and maintenance server; and a radio frequency server.

- 50 [0006] Therefore, in accordance with the previous summary, objects, features and advantages of the present invention will become apparent to one skilled in the art from the subsequent description and the appended claims taken in conjunction with the accompanying drawings.

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BRIEF DESCRIPTION OF THE DRAWINGS**[0007]**

- 5 Figure 1 is a diagram of separating wireless access from the Core Network;
 Figure 2 is a diagram of the LSF/NSF (core) Layer functional service components;
 Figure 3 is a diagram of the Radio Access Network Layer functional service components;
 Figure 4 is a diagram of the Mobile Terminal Layer functional service components;
 Figure 5 is a diagram of Protocol layers and interactions;
 10 Figure 6 is a diagram of Service layer interfaces;
 Figure 7 illustrates the connectivity of the Access Management Layer;
 Figure 8 is a diagram of AML functional components;
 Figure 9 is a diagram illustrating step 1 of the access session establishment procedure;
 Figure 10 is a diagram illustrating step 2 of the access session establishment procedure;
 15 Figure 11 is a diagram illustrating step 3 of the access session establishment procedure;
 Figure 12 is a diagram illustrating step 4 of the access session establishment procedure;
 Figure 13 is a diagram of the service session invocation procedure;
 Figure 14 is a diagram of the functional component interaction sequence flow;
 Figure 15 is a diagram of an overview of an access scenario at the AIL-AML;
 20 Figure 16 is a diagram of an QoS change request;
 Figure 17 is a diagram of use of default QoS to establish call/session;
 Figure 18 is a diagram of a call/session invocation request;
 Figure 19 is a diagram of power up registration;
 Figure 20 is a diagram of the use of default parameters; and
 25 Figure 21 is a diagram of an example implementation of the various layers of the architecture of the preferred embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

- 30 **[0008]** The present invention can be described with several examples given below. It is understood, however, that the examples below are not necessarily limitations to the present invention, but are used to describe typical embodiments of operation. Additionally, a list of abbreviations and a glossary will be listed first to facilitate a better understanding of the invention.

35 **Abbreviations****[0009]**

- 40 AAA Authorization Authentication Accounting
 AIL Access Interface Layer
 AML Access Management Layer
 ATM Asynchronous Transfer Mode
 CDMA Code Division Multiplex Access
 CN Core Network
 45 COA Care Of Address
 COPS Common Open policy Service
 dB data Base
 DHCP Dynamic Host Configuration Protocol
 DNS Directory Name System
 50 DEN Directory Enabled Networking
 DS Directory Server
 FR Frame Relay
 HDLC High Level Data Link Control
 IP Internet Protocol
 55 ITU International Telecommunication Union
 LAN Local Area Network
 LDAP Lightweight Directory Access Protocol
 LDP Local Decision Point

	LSF	Local Serving Function
	L1	Layer 1
	L2	Layer 2
	L3	Layer 3
5	MH	Mobile Host
	MM	Mobility Manager
	MPLS	Multi-protocol Label Switching
	MS	Mobile Station
	NGWN	Next Generation Wireless Network
10	NSF	Network Serving Function
	OSI	Open System Interconnection
	PDP	Policy Decision Point
	PPP	Point to Point Protocol
	PSTN	Public Switched Telephone Network
15	RADIUS	Remote Authentication Dial-In User Service
	RAN	Radio Access Network
	RF	Radio Frequency
	RSVP	Resource Reservation Protocol
	RTCP	Real Time Control Protocol
20	RTP	Real Time Protocol
	QoS	Quality of Service
	SDP	Session Description Protocol
	SIP	Session Initiation Protocol
	SMS	Short Message Service
25	SS	Session Server
	TCP	Transmission Control Protocol
	UAC	User Agent Client
	UAS	User Agent Server
	UDP	User Datagram Protocol
30	UMTS	Universal Mobile Telecommunication System
	UWN	Unified Wireless Network
	WAG	Wireless Access Gateway

Definition of terms

- 35 [0010] UWN: The Unified Wireless Networks is the IP centric core-network consisting of LSF and NSF network components. The UWN is assumed to be independent of air interface technology. The interfaces between system components of the UWN are based on the LAN/WAN technology and uses client server architecture.
- 40 [0011] 2G: The current wireless network components are referred to as the second-generation components. The 2G-network component uses industry-defined protocols and interfaces to communicate between the system and network components.
- 45 [0012] 3G: The future wireless network components evolved from the 2G components are referred to as the third generation components. In the description of the preferred embodiment it is assumed that the 3G will be backward compatible to the 2G. For an example, 3G mobile (voice mode) terminal is capable to act as 2G mobile (voice mode) in voice call support. In addition, 3G will be able to support new standards for making a multi-media call using newly defined standards. The gateway devices may be used to support 2G and 3G components.
- 50 [0013] NG: The future wireless network components that evolve from the 3G components are referred to as the Next Generation components. The NG components are assumed to take full advantage of the IP centric network infrastructure and eliminate the need of gateway devices. End devices will become smarter with the capability of communicating without the need for the gateway or mapping functions.
- 55 [0014] NSF: The NSF is one of the network components of the UWN architecture. It consists of several system components. These components may include legacy components through the necessary interfaces or their functional equivalent suitable to the IP centric environment. Some of these components are HLR, SCP, Unified Directory, AAA server, SN, IP Service Platform (provides value added applications to the client), etc. Network Serving Function (NSF) is the global home component of the UWN that owns the mobile user's subscription.
- [0015] LSF: The LSF is one of the network components of the UWN architecture. It consists of several system components. Some of these components are CS, MM, CD, DHCP, DNS, Gateway devices, etc. The Local Serving function (LSF) is the serving component of the UWN that provides services to local and visiting wireless subscriber in that area.

- [0016] RAN: The Radio Access Network is the system component of the wireless network that provides radio control functions used in transmitting and receiving control and data information between mobiles and core network. The RAN itself is air technology dependent. However, it is evolving to provide independent functionality towards the IP centric core network. On this basis, RAN is assumed to have distinct radio interface and access management components.
- 5 The radio management components provides the radio independent functionality towards the IP centric core network.
- [0017] AML: The Access Management Layer is the service layer of the RAN that consists of radio management and access management components.
- [0018] AIL: The Access Interface Layer is the service layer of the RAN that consists of air link interface handling components.
- 10 [0019] WAG: The Wireless Access Gateway is the entity that interfaces with the wireless access network such as 3G RAN and provides controlling capabilities to facilitate the RAN resources to meet users' requirements such as bandwidth management and also to interface with the intranet or Internet components.
- [0020] WGW: The Wireless GateWay is the entity that interfaces and provides gateway functionality between the traditional wireless access such as BSC and the IP centric network. The WGW is assumed to provide merely tunneling capabilities to transport messages such as DTAP or BSMAP between IP centric network and the traditional 2G-access controller. This definition is not used in the description of the preferred embodiment. However, it is provided just to differentiate the meaning of WGW with the WAG described earlier.
- 15 [0021] UAC: User Agent Client is the first entity within the wireless network that assumes responsibility on behalf of the user to communicate with the core network or external network components. The UAC facilitates the activities in the ingress direction. Typically, the UAC is capable of communicating to the external servers directly. However, in some instances the UAC may convey such need to the UAC proxy.
- [0022] UAS: User Agent Server is the entity that receives requests from the UAC or the UAC proxy. It facilitates the activity in the egress direction.
- 20 [0023] UAC proxy: User Agent Client Proxy takes responsibilities on behalf of the UACs to send appropriate requests to the server.
- [0024] UAS proxy: User Agent Server proxy is the first entity within the wireless network that assumes the terminating responsibility on behalf of the receiving user. However, it has the ability to forward or redirect the call/session to other external components. The UAS-proxy facilitates the activities in the egress direction. Typically, the UAS proxy is capable of communicating to the terminating user directly. However, in most instances the UAS-proxy just conveys such information to the UAS that in turn communicates to the end user.
- 30 [0025] Ingress: This term is used for those activities that occur in direction from the mobile host to the network.
- [0026] Egress: This term is used for those activities that occur in direction from the network to the mobile host.
- [0027] Outgoing call/session: This term is used as defined by the bellcore documents. This term is used for the call/session activities that originated from the mobile host and progresses to other network through the serving network.
- 35 [0028] Incoming call/session: This term is used as defined by the Bellcore documents. This term is used for the call/session activity that originates from the external network and progresses to the mobile host through the serving network.

Introduction

- 40 [0029] The distributed IP centric Wireless Internet - NGWN architecture is centered around IP mobility management, call/session management, and network management. The scope of the description of the preferred embodiment is to explore call/session management services.
- [0030] The call/session management services consist of three functions. These functions are: 1) establishing an access session between the mobile host and the serving network; 2) an invocation of a service session by the end user; and 3) facilitating network resources to establish point to point or point to multi-point virtual connection.
- 45 [0031] The establishment of an access session attaches the mobile host to the serving network. During the establishment, subscribers' are authenticated and granted either a specifically requested, or a default, bandwidth with the desired quality of service. Once the access session is established, the mobile host becomes IP capable and can reach, or be reached, any other devices. The access session remains active while the mobile host is attached to the serving network.
- 50 [0032] Once the access session is established, the user can invoke a service session. The user is provided with user capabilities and network preferences to use services from the serving network or externally accessed services. Although the user is provided with many choices of service invocation, the one of the main components is call/session control services. The management of call/session control is distributed to a set of appropriate servers (functions) within the access management and Local Service Function (LSF) network service layers. This distribution allows access relevant activities to be coupled with the access dependent service layers, and policy decision making activities coupled with the access independent layers. The services originated at the application level are configured with the appropriate application servers at the LSF service layer. In addition, call/session control services are part of the access management
- 55

services that aids to facilitate in establishing point to point and point to multi-point virtual connections.

[0033] The main components of the Unified Wireless Networks (UWN) consist of IP mobility management components, call/session management components, network management control, and gateway devices that interface with other systems supporting different protocols. The network management control functionality is also important but dependent on the full definition on the other components. The gateway functionality is also required along with the other appropriate components of the UWN.

[0034] The description of the preferred embodiment focuses on the functional components of the call/session management services. These functional components are distributed in distinct network service layers based on their role. The network access and user service related functional components are distributed in the access management and service management layers respectively. Further, the service management layer is distributed into a local network service layer and a global network service layer.

[0035] Thus, realization of functional components and their appropriate separation into access and service layers have allowed separating network access and service management functions from the media transport. This enabled the end user to have choice of using serving network services or to use external Internet services. Detailed procedures to establish the access session and invoke the service session are discussed below.

Objectives/Requirements

[0036] The call/session management tasks are expected to achieve objectives for three basic functions. These functions are comprised of first, establishing, maintaining and terminating an *access session* between mobile host and the serving network. Second, providing network services to the mobile host that allows a mobile host to establish a *service session*. And third, facilitating transport resources of the serving network to establish a *transport session* based on the mobile hosts' need of bandwidth with a desired quality of service. The desired objectives to achieve these three functions are described below. Moreover, the call/session management functions are real time sensitive where access of decision making information and propagation delay through the network infrastructure plays an important and critical role. Additional objectives related to performance, capacity, and scalability are also identified for real time and other similar issues.

Access, Service, and Transport Session Objectives

[0037] These three basic functions of the call/session management services are identified and elaborated to distinctly depict the differences within the Wireless Internet.

Access Related Objectives

[0038] An establishment of an access session enables the mobile host to establish a point of presence at the local serving network. During access session establishment, subscriber management services are executed. These services include admission policy control decision, provisioning of default air link resources, and establishing the virtual packet channel that allows mobile hosts to interface with the external Internet network. The following paragraphs describe the access related objectives in detail.

[0039] Any access dependent requirements for subscriber management services should be identified. The subscriber management services include authentication, authorization, usage selection and usage constraints associated with subscriber.

[0040] User authentication and authorization are based on digital certificates/signatures, and is provided by an authentication server.

[0041] Usage selection and user constraints are based on the subscriber profile and network policy.

[0042] Provisioning the local serving functions with access and usage profile in order to provide allowed access and usage services to the mobile host.

[0043] Handling of flexible bandwidth provisioning and supporting requirements.

[0044] Handling of accounting requirements based on flat rate, per packet, time used, and/or Quality of Service provided.

[0045] Handling of data speed requirements of up to 144 kb/s for vehicular users, up to 384 kb/s for outdoor to indoor mobility, and up to 2 Mb/s for indoor and Pico cell environments. Handling of Quality of Service requirements.

Service Session Related Objectives

[0046] The service session enables an end user to use services provided by the serving network. Also, an end user can use the serving network services to dynamically change network transport resources. That will allow an end user

to access globally available network services at the required bandwidth for a desired quality of service. The following paragraphs describe a few objectives:

- [0047] Identify serving network services to facilitate use of access network application servers to provide services independent from the subscriber's home network.
- 5 [0048] Identify any interaction needed in providing global network services that are based on service level agreements between other networks (home or third party).
- [0049] Identify serving networks' role in enabling end user to form a private network within the scope of serving the Wireless Internet.
- [0050] Identify scheme for reporting network resource usage.
- 10 [0051] Establishing and managing voice, paging, Short Message Service (SMS), and circuit and packet data oriented services (e.g. multi-media conference, on-line subscription, etc.).
- [0052] Service capabilities related to information and functionality such as dynamic negotiation of QoS, use of Intranet service and use of communication resources.

15 **Transport Related Objectives**

- [0053] The transport session activities enable the mobile host to use the network's air and virtual packet channel path resources. The following paragraphs describe a few identified objectives.
- [0054] Establishing bearer connection path for an air link and virtual packet channel using serving network's resources.
- 20 [0055] Facilitating Point to Point, Point to Multi-point and Multi-point to multi-point connection.
- [0056] Facilitating use of underlying network infrastructure resources such as ATM, FR, or Ethernet.
- [0057] Facilitating use of payload coding/decoding task identified by the payload mediation function of the local serving function.

25 **Other Related Objectives**

- [0058] The following paragraphs describe a few more important objectives.
- [0059] Performance objectives :
- 30 [0060] Minimum packet delay; ITU recommends roundtrip delay less than 300 ms.
- [0061] Minimum packet loss, such that no noticeable degrade in voice quality and the performance of fax.
- [0062] Maximum throughput via a virtual connection
- [0063] Optimized bandwidth distribution

35 **Challenges**

- [0064] An identification of the Call/Session management functions and objectives for the newly defined NGWN are relatively straightforward. However, the feasibility of such objectives to implement and achieve quality of traditional networks in the newly defined Wireless Internet is not an easy task; it is a paradigm shift. It involves many unknowns and challenges. An attempt is made here to list such challenges in this section along with the solutions in subsequent sections.
- 40 [0065] Identify interfaces and signaling objectives between mobile host and network components. More precisely between:
- [0066] Mobile host and network's access management layer (AML) functional components to establish access session.
- 45 [0067] Mobile host and network's local service layer functional (LSF) components to establish service session.
- [0068] Mobile host and home network service layer functional components (NSF) to establish Virtual Home Environment.
- [0069] Achieve distributed transparencies for applications.
- 50 [0070] Achieve optimized information caching significant to established clusters and domains.
- [0071] Reduce dependencies for availability and reliability of network components due to network problems, server problems and faulty software.
- [0072] Achieve scheme to reach neighboring domains directly avoiding hierarchical intervention.
- [0073] Identify both connection oriented and transaction-oriented services.
- 55 [0074] Identify inter-working between non-IP access network and IP-based core network.

Architectural Framework: Emphasizing Call/Session Management components

[0075] This section establishes context for the call/session management services. An architectural framework is illustrated mainly emphasizing the functional service layers and components. It starts with separation of functional boundaries and later decomposes functional components in detail. The interfaces and interactions between network entities and inter-working between functional service layer components is described below. However, in order to illustrate the separation of functional layers and the respective inter-working between layers, the description will not flow from figure 1 through figure 8 sequentially, but will refer to the figures out of order. However, the elements are numbered consistently throughout figures 1 through 8 so as to help the understanding of the description.

Architectural overview

[0076] The NGWN/Wireless Internet is an IP centric distributed Local Area Network (LAN) based architecture. The network components in this architecture are functionally separated as required to fulfill the need of wireless telecommunication and is also suitable to integrate with other data and telecommunication networks.

[0077] The NGWN architecture provides the separation of applications/services control that interacts with the end user and management of the physical infrastructure. Figure 1 identifies the separation of wireless access 102 from the core network 105 at the access management layer 107. Figures 2 through 4 illustrate the distributed architecture with suggested functional service components. The main focus of interest is on the functional service components at the LSF 106/NSF 108 network layer and the Radio Access Network Layer 102. Figure 2 identifies the core functional service components associated with the LSF 106/NSF 108 network layer. Figure 3 identifies the access interface and access management specific functional service components. As shown in figure 2, the WAG functional components 200, 202 provide the bridge function between the local service layer 106 and the access management service layer 100.

[0078] Now referring to figures 1 and 2, the WAG component 101 that is attached to the LSF network 106 represents the access gateway point for the technology dependent functional components. Multiple access gateway points 202 can be attached to the LSF network 106. This provides flexibility in network scalability. The detailed functionality of the WAG components is represented by the Access Management Layer components 100 and shown in figure 3. The LSF 106/NSF 108 service layer functional components on one side of the WAG provide the application specific controlling functions. The access side 104 of the WAG provides the technology dependent access functions.

[0079] The access points 200 and 202 shown in figure 2 as the Wireless Access Gateway, separate the network in two distinct layers. First, the LSF106 /NSF 108 network layer that consists of common core functional service components required for telecommunication network. Second, the Radio Access Network layer that is partitioned into Access Interface Layer (AIL) 104 and Access Management Layer (AML) 100 consists of access interface and access management specific functional service components. Through out the description of the preferred embodiment, an access point that is attached to the LSF 106/NSF 108 (core) network layer is referred for wireless access point. The separate access point is required because of the different air technologies used for wireless access. Likewise, any other technology such as a wireline telecommunication system or a LAN based system can be attached to the LSF/NSF network layer. For different types of access points attached to the core network, the appropriate corresponding controlling core functional service components can be added and configured into the network.

[0080] The LSF/NSF service layers provide the core network functions. Some of the core network functions are listed in Appendix B. Depending on the scalability requirement of the network, the functional service components within the LSF 106 and NSF 108 network layers can be distributed or consolidated based on the desired hierarchy.

[0081] The access management layer 100 as shown in figure 3 provides the controlling functionality relevant to access management and RF management activities. Please note that the RF management activities and access management activities are part of the Radio Access Network layer 102. However, only RF management activities are closely coupled with the AIL 104 and access management 100 activities are closely coupled with the core network. Thus, it is possible to separate the access management activities from the RAN layer. Another major activity is the connection management function. The RAN also provides other associated functions such as local decision making domain specific database, resource control for radio resources, transmission facilities associated with the connection management function, and network management activities. These functions are illustrated in more detail in figure 8. The RF management function of the AML interfaces with the AIL service components and service components within the AML. It performs functions such as channel management, resource management at the AIL level, and policy decision functionality with respect to the AIL needs. The access management functions of the AML interfaces with the core components towards the network side and service components within the AML. The major access management function includes the ingress and egress activities that take place through the access point. Figure 8 shows distributed access management functions. The 'Access' function 800 provides ingress activities, while 'Termination' 802 and 'Paging' 804 functions provide an egress activities. The layer 3 protocol signaling messages between the mobile host and the serving network received at the AIL are distributed to the pre-configured functional service components. The layer 3 protocol

signaling accomplishes basic inter-working activities with the terminal device. Some of such activities include mobility management activities, location updating, radio resource selection, power control adjustments 806, and channel assignment and reassignments. Also, it may include network layer (L3) originated call control and supplementary services as traditionally used in legacy mobile systems. The AML components are pre-configured to communicate with the AIL components and tunnels appropriate signaling and data information.

The AIL components provide the radio access functions.

[0082] Now referring back to figure 1, the AML 100 is the dividing point 103 between the core network 105 and access dependent controlling functions 102 and 104. The components within the access management layer 100 take the role equivalent to the policy enforcement while the LSF 106/NSF 108 (core) service layer components provide the role equivalent to the policy decision. In order to expedite the policy decision and also to take advantage of the distributed infrastructure, the WAG (the access point attached to the LSF network) domain database is considered at the AML, which facilitates the policy and subscriber related default parameters and access related status information.

[0083] The functionality of various functional components in each service layer is out of the scope to describe in the description of the preferred embodiment. However, Appendix A provides a brief description for some of these components. The access management functional component as shown in figure 3 plays an important role in providing call/session management services. The distribution of access management component functionality along with other AML components is described in figure 8. The access management component performs ingress and egress activities. Logically, access management functions can be further distributed into access (origination) function for ingress activities and termination 802 and paging 804 functions for egress activities. These functions can be physically located in a single (access management) server 800. However, they can be distributed in different servers as they provide distinctly independent functionality. These functional service components are capable of sending/receiving application level messages (from/to user) as well as layer 3 protocol messages over IP (from/to AIL) that take place between the mobile host and the serving network. The detailed functions of these components are described later. However, a brief description is provided here to establish context.

[0084] The access management 800 of the AML takes the role of user agent in the network domain. Within the access management function 800, the access function takes the role of user agent client. With respect to the call/session management service perspective, this functional component handles ingress activities such as registration and origination. Similarly, the termination function 802 takes the role of user agent server and provides the proxy functions for egress activities. The paging function 804 is the further distribution of the egress activities that is associated with the users at the cell level 808. The location-tracking function (defined as handoff function later) handles handoff activities. The location-tracking function interfaces with the LSF service layer component - mobility manager for periodic location update, and inter system (WAG to WAG domain) and inter network domain controlling functions such as hand-off.

Interfaces between network entities

[0085] The functional service components are distributed in appropriate network service layers as shown in figure 2 and figure 3 that interact with each other using various interfaces. Although the logical interface model is not shown in the figures, the lower layer (L1-L2) interfaces (shown in figure 5) are assumed to be Ethernet. The interface at the transport layer is either TCP or UDP that is based on the delay sensitivity and reliability requirement. The "other" in figure 5 indicates the support of application level framing (ALF) and support of timer associated with transport layer protocols in order to enhance transaction level capabilities such as controlling congestion and canceling transactions. Application layer protocols are text based and based on the currently being defined Internet protocols.

[0086] The logical interface model includes primary control and data path interfacing to the Wireless Internet. Unlike the LAN based application interfaces in most interfaces mentioned in this model, the air link interface is a specific interface. The mobile host interfaces at the serving network on the technology dependent air interface uses network layer protocol messaging. The radio access interface layer, as shown in figure 3, terminates the network layer air technology dependent messages. Based on the type of messages received at the access interface layer, they are distributed to the pre-configured functional components at the access management layer. Detailed procedures are explained later in the description of the preferred embodiment.

[0087] Although the details of the Mobile Terminal Layer are not discussed much in the description of the preferred embodiment, figure 4 shows an example of how the functionality of the mobile host can be separated into two layers: a wireless interface layer and a mobile application layer.

Application inter-working

[0088] Figure 5 depicts the protocol layers and interactions between network entities. It establishes the main context for application interactions between various network components. It shows the protocol interfaces between OSI layers that inter-work to accommodate air interface and LAN based connectivity. The description of the preferred embodiment only focuses on activities that take place above the transport layer in case of LAN based architecture and at the network layer in case of air interface.

[0089] The following sections describe the interactions between mobile host and access network components, mobile host and local serving function components, and mobile host and home network components.

Interactions between mobile host and access network

[0090] The Access Management Layer and the Access Interface Layer are the part of the Radio Access Network. The AML service components provide the access dependent control functions. The technology dependent network layer (L3) protocol terminates at this point. The AML service components are logically distributed into different functions as shown in figure 8. A signaling distributor between AIL and AML distributes messages to the pre-configured functional components (servers). With respect to the call/session management services, the access, termination and paging functions play an important role. These components interface with the LSF service components in order to provide services to the AIL and the mobile host. The LSF service components interface with the NSF service components in order to provide services to the access management components.

[0091] The following interactions occur between the mobile host and the access management service layer:

[0092] The AML components interact with the network layer of the mobile host to establish an access session. (L3/IP between AIL and AML)

[0093] The AML components interact with the AIL components to bring the mobile host on the traffic channel.

[0094] The AML components interact through the connection management component to establish point to point protocol path that allows the mobile host to access any other IP capable devices.

[0095] The network preferred call/session control services are handled through the access management components.

[0096] Handoff, power control, and paging functions related handshakes with the mobile host are controlled by the AML components.

[0097] Interactions between mobile host and CN/LSF network service components

[0098] The LSF network service components provide specific services to the access management components during establishment of an access session and service session with the mobile host.

[0099] The subscriber management and policy decision services are provided during an access session establishment with the mobile host.

[0100] The policy decision services are provided during user session invocation.

[0101] Intranet services are provided by the LSF service components through the specialized application servers.

[0102] Interactions between mobile host and CN-NSF/Global network Service components

[0103] The NSF network service components provide services to the LSF network service components during establishment of an access session with the mobile host.

[0104] The subscriber management services are provided during an access session establishment with the mobile host.

[0105] Facilitate to publicly available server accesses.

[0106] Direct home network accesses.

[0107] Interactions between network service layers

Inter-working between service layer components

[0108] The access management layer components and the LSF/NSF service layer components are the main network components that play the significant role in controlling call/session management. The functional components within an access management layer are the edge components through which mobile users in a area accesses the core network for access establishment service, service session invocation service and intranet services or external network access services. The AML is comprised of many distributed functions. These functions are explored in subsequent sections including access (Origination: User Agent Client), termination (Termination: User Agent server), protocol servers (optionally at AML but not at LSF service layer), power control, resource control, handoff, paging, and connection management (Transport Network). The functions within LSF/NSF network service layer include service broker, session server, payload mediation, and AAA+ (accounting, authorization, and authentication) servers. The components are described in greater detail later.

[0109] How these components interact with each other as well as with end user and establish an access session, service session and transport session is also described later in the text. The access function facilitate to establish an *access session* that interact with the mobility manager to provide the functionality and the context needed to grant and support the user in accessing NGWN - Wireless Intranet services. Typical access functions performed by the network domain include an establishment of an authentication, authorization, usage selection, and usage constraints. At the end of establishing access session, the serving network is configured and provisioned with the subscriber's profile to provide appropriate access role, and usage role to the end user. Further, appropriate access functions are instantiated within the access management layer that interacts with mobile host to facilitate service session invocation and monitoring usage functions of the network resources. These instantiated functions interact with the session and accounting servers during the service session. The access functions within the AML take the role of User Agent in the network domain.

[0110] The session server component of the LSF/NSF network service layer facilitates establishment and maintenance of a *service session*. It provides the functionality needed to satisfy end users' request for desired services. The functional components within the LSF/NSF network service layer provide services to the access management layer and to the end user in establishing functionality and context involved in the negotiations of parties, configuration and QoS to be associated to the execution of a service. These services are unlike the call model services that facilitate in establishing connection-less or connection oriented call/session.

[0111] The AML of a particular domain must establish an association with the session server of the LSF/NSF network service layer in order to provide call/session services to a mobile. It is possible for the AML to have association with multiple session servers. However, the AML must associate with a single session server to complete initiated transaction. It is also possible to have many transactions during call/session establishment. During each transaction the AML may use a different session server. This implies that the AML maintains call/session states.

[0112] The session server provides services such as address translation, location service, and bandwidth management and admission policy control. It interacts with the AML for instantiated access functions to provide desired call control and other session services to the mobile host.

[0113] The session server is capable of accessing any of the AML components. This enables the session server to update the domain specific local database within the AML, monitor resources and achieve flexibility (optional) to manage connections for traffic. Updating local domain database provides necessary intelligence to the AML components to perform default capabilities quickly and efficiently. Also, the session server uses services from home (global) network components (NSF) for the purpose of authentication, authorization, accounting, policy related decisions, and globally provided services. The session server performs the function of redirect server in terms of SIP context (SIP Session Initiation Protocol - RFC 2543) or similar to gatekeeper function in terms of H.323 context for the call/session control services.

[0114] The connection management component of the AML provides the function of establishing *transport session* that establishes an end-to-end virtual connection, and handles multi-point and multi-media connections. It interacts with the session and accounting servers for policy and usage monitoring and reporting functions.

Call/Session management specific: components, services, and procedures

[0115] This section describes call/session management relevant functional service components within each network service layer and services and procedures that establish access session and transport sessions. The service components within an access management layer of the RAN layer and service components within the local service layer of the LSF/NSF network services layer plays an important role in providing call/session management services.

Access Management Layer (AML) components

[0116] The AML functional component position is between the radio access interface layer and the core network components as shown in figure 1 and figure 7. The AML component performs controlling and policy enforcement functions. It controls activities that take place at the access interface layer. Also, it controls interface activities associated with the user during access session establishment and service session invocation. It controls connection management activities that establish and monitor the point to point and point to multi-point virtual packet channels.

[0117] The network and user specific preferences are executed here based on the policy decision provided by the LSF/NSF network layer service components. The local domain database is updated with limited relevant information during access session establishment and service session invocation that expedites real time critical policy decision execution. For an example, an origination request arriving at the access management server examines the requested bandwidth with the allowed default permission through the local domain database. If the requested bandwidth matches with the allowed default, an access management server facilitates the requested bandwidth through the resource control function of the AML. If the requested bandwidth is other than default, an access management server may consult

with the session server to take further action.

[0118] These functions can be physically distributed in different servers within the AML as network capacity demands. The AML functions (i.e. components) are pre-configured with the local service layer components to provide services to the mobile host during access session establishment. Additional components are instantiated and configured at the end of access session establishment. This is done based on the capabilities granted to the users and network capabilities to provide additional services.

[0119] Figure 6 illustrates how some of the components within each layer interfaces to some of the other components and is only meant to illustrate an example of the components described in detail throughout the description of the preferred embodiment.

[0120] Figure 7 illustrates the respective position of AML in Wireless Internet. Figure 8 illustrates the functional components within the AML. The functional components within the AML are pre-configured with a signaling router that interfaces between AIL and AML. The signaling packet to/from the radio access interface layer arbitrates at the signaling distribution function of the AML and distributes to the pre-configured AML components based on the type of signaling (e.g. related to call/session processing, mobility management, supplementary services, radio resource, etc.). An access function plays an important role in ingress direction while termination and the paging functions play an important role in egress direction. The access function takes the role of user agent on behalf of the end user. An access function involves in initial dialog with the mobile host. At network layer, the mobile host communicates with the access function using network layer messages. Intelligence at the access function uses local domain database in performing default services. For higher-level policy decisions, it accesses the session server at the LSF network service layer.

Activities of the AML components are described below:

[0121] **Access function** - Access function takes care of ingress related call/session management activities. These activities include registration and origination. An access function is the first signaling termination point with respect to ingress call establishment. It executes the policy enforcement functions. The access function of the AML takes the role of a user agent in a serving network. It interfaces with the mobile host to provide access session establishment service. During initial registration, it interacts with the mobility manager of the LSF network layer component that facilitates the subscriber management services. Upon successful completion of the subscriber management services through the mobility manager, the local domain database is updated with user and network preferences. The local domain database provides the local decision point functions. This expedites the domain specific activities during service session invocation and through out the active access session.

[0122] Further, an access function facilitates the establishment of a traffic path (establish PPP link) between the mobile host and the connection management component. The purpose of this action is to establish an access session between the mobile host and the serving network. The access function of the AML does this in two steps. First, the access function interacts with the RF management (resource control as shown in figure 8) component to bring the mobile on a traffic channel. Second, the access function interacts with the connection management component through which the PPP protocol messages handshake to establish IP address service point at the mobile host. The mobile host can negotiate the choice of IP address to be used; either network provided or mobile provided. This establishes the transparencies between the mobile host and the serving network. The access function informs the session server of the LSF network layer about the completion of the access session.

[0123] At this point, the session server has direct addressing capability to the mobile host to provide user capabilities and network preferences. Based on the usage and preferences granted to the mobile host, an appropriate service session manager function is instantiated within the access management layer domain. The user application interacts with the service session manager for service invocation and network service requests.

[0124] The access function takes the role of either user agent client or user agent client proxy depending on the need that is based on the capability of the mobile host. Please note that access function implies that the activities may be provided by an instantiated session server manager or handed over to the appropriate protocol servers. When the mobile host is capable to control call/session-handling activities, the mobile host takes the role of user agent client. The access function provides the role of user client proxy if requested. The mobile host has choice not to use access function as client proxy and may contact any desired client proxy or directly to the end user agent server. The mobile host keeps track of state machine. If the mobile host requests to the access function to aid in further call/session-handling activities, the access function takes the role of user agent client proxy. In this case, the access function is taking role of client proxy may interacts with the session server that provides the role of redirect server. Also, the access function can play role in two possible modes. First, an idle mode in which it provides call/session-handling transaction services when requested but do not keep track of call/session state machines. Second, an active mode, in which access function provides call/session-handling transaction services and keep track of call/session state machine.

[0125] When the mobile host is not capable of handling call/session activities, the access function receives request from the mobile host. The access function takes the role of user agent client, interacts with the session server for

admission control and policy decision if required. The access function performs the outgoing call/session activities. The access function keeps track of state machine.

[0126] Termination and paging function - Termination function handles egress activities related to the incoming service session (call control activities) requests. Why do we need the termination function? In an IP environment, with the fact that each IP capable mobile host is addressed by a specific IP address, an external caller when trying to reach a mobile host in a Wireless Internet, it can reach directly without any intervention from the wireless access. However, this is only true when the mobile host is attached to the serving system using its permanent IP address. Because of the transient characteristics of the mobile host it is more suitable to assign a domain specific IP address within the Wireless Internet. In this case, once the domain specific address is made globally available by linking with the mobile host's home then the external caller only needs to find domain specific termination-proxy server. The termination-proxy server associates the current location of the callee within that domain with the current paging server (user agent server).

[0127] Thus, the termination function acts as a user agent proxy server for the user agent servers associated within the AML (notice cloud shown in figure 8). The termination function provides the first signaling termination point with respect to egress call establishment. It executes the policy enforcement functions. The local domain database provides the local decision point functions. This expedites the domain specific activities during termination service session establishment. The termination function interacts with domain database to get information for handling incoming request. If the end-user is not recognized, it interacts with the session server of the LSF component to take further action. In terms of SIP context (SIP RFC 2543), the session server performs function similar to the redirect server. Similarly, in H.323 context, the session server performs function similar to the gatekeeper. The termination function uses services from the session server and mobility server of the core network for various services that may include authentication during termination, current location information and policy-related decision.

[0128] If the end-user is recognized (i.e. registered within this domain) and the requested service is allowed, the termination function directs the request to the appropriate paging function (user agent server) to page the end-user or activate the traffic path from either standby or dormant mode. The paging functions (user agent servers) are associated with the unique cells within the access management domain serving area. The paging functional component keeps track of the call/session state machine as it is acting as a user agent server on behalf of the mobile host.

[0129] The termination and paging function interacts with the RF management server (resource manager) to establish a radio link connection. As mobile host is attached to the serving network, a domain specific IP address is already assigned. So in terms of SIP context (SIP RFC 2543), this IP address is returned in the contact header when returning response to the INVITE message. The termination or paging function interacts with the connection management function to establish a transport session.

[0130] Protocol servers (or functions) - The access management functions are closely coupled with the protocol servers or functions. The protocol functions are the different code points within the system specific to the type of protocol (such as SIP, H.225, H.245, RSVP, MPLS, etc.) used for the specific activities (such as session establishment, quality of service request, secure virtual path establishment, mobility specific, etc.). These functions can be part of the access management functions and instantiated for each service session invoked. Or, these functions can be separated in different servers and access management functions can hand over the specific requests to these servers as needed. The role of these servers varies depending on the type of protocols. For an example, in SIP context, such server provides functional role as proxy server. Similarly, in H.323 context, such server provides functional role as H.323 gateway.

[0131] The location of these protocol functions or servers is not appropriate at the LSF network layer as they are closely coupled with the access management activities. For the simplest network hierarchy, these functions or servers can be associated with one WAG (access point) domain. As network scalability increases, i.e., additional access points are added, other access points can access these servers established at a single geographically convenient location. Alternatively, it is possible to locate these protocol servers along with other Intranet application servers.

[0132] Once access management hand over request to the appropriate protocol servers, these servers create direct links with the end user and takes the responsibility to interact with the connection management functions to establish appropriate transport session.

[0133] Connection management function - The connection management function is the part of the AML component. It provides the third and final phase of the call/session management services that facilitates in establishing transport session. It receives transport session establishment request from the access (user agent client) function or instantiated session service manager during the outgoing service session establishment. Similarly, the termination (UAS proxy server) and/or paging function (user agent server) requests transport session establishment during incoming service session establishment. Based on the request, the connection management function facilitates to establish the point to point or point to multi-point virtual packet channel. The connection management function monitors and records usage activities. Like session service manager, the connection session manager is instantiated for each transport session establishment. The connection session manager for the transport session takes care of providing required quality of service and use of appropriate network infrastructure as described earlier.

[0134] **Configuration Manager** - the configuration management function at the AML service layer facilitates reconfiguration of AML service layer components. It also facilitates location tracking (handoff) with addresses of neighboring location tracking components that are used for handoff activities during movement from one AML to another AML.

5 [0135] **LSF/NSF network service layer components** - There are many functional components that are involved in providing call/session management services. However, only some of these are significant for the purpose of the description of the preferred embodiment and described here.

[0136] **Session server** - The session server is one of the call/session management service components at the local service layer. The primary function of the session server is to interact with the AML service components to provide call/session management services. More precisely, it interacts with the access function and the termination function within the access management server of the AML service layer. Also, it interacts with the connection management function at the AML for usage monitoring and recording purpose. Once the access session is established between the mobile host and the serving access network, the access function interacts with the session server. At this time, the session server may configure the mobile host with available network preferences and users granted capabilities. Also, the session server provides important IP addresses to the mobile host (possibly using html) that can provide value-added services. The call control services are some of the many other services the mobile host can invoke. The session server at the LSF service layer along with access and termination functions at the AML service layer provides most of the call/session control services. The typical functions facilitated by the session server includes address resolution, call/session admission control, policy control decisions and access accounting control.

20 [0137] Other issues such as address translation and finding terminating proxy servers are not explored here. However, it is important to mention that the session server is assumed to perform functions similar to the redirect server identified within the SIP component definition (SIP RFC 2543). An identification of functionality for admission policy control and bandwidth management is the challenge with respect to the 3rd generation infrastructure. In addition to these, the role of session server in providing location-based applications and its interactions with the mobility manager server is also a challenge. These issues are differed at this time.

25 [0138] **Database management (directory services)** - The call/session functions related to a subscriber are typically based on the subscriber's profile. Such information in wireless network is typically centrally located at the subscriber's home NSF layer or at global level. In order to take advantage of the distributed network, subscriber's profile and related information need to be distributed in appropriate domains. Such distribution should be to a level where access point dependent components (e.g. session server, MM server) and radio dependent components (e.g. functional components within the AML) can take necessary decision independently. Such distribution will expedite the call/session processing and reduce the lengthy delay involved in accessing centrally located database and hence improve performance.

30 [0139] **Call/Session management services** - The ultimate objective of the Wireless Internet is to provide the end user an access through the network, provide choice of user desired services (Intranet or external Internet, etc.), and finally, the control and monitor capability for network resources used. The call/session management services facilitate these objectives. Three basic functions were briefly identified earlier. These functions are listed in the following paragraphs again.

Establishing an access session between the mobile host and the serving network

40 [0140] The establishment of an access session facilitates the mobile host to attach to the serving network. During the establishment, subscribers' are authenticated and granted for requested or default bandwidth with desired quality of service. The local decision point within the access management layer is updated and appropriate service components get configured. Once the access session is established, the mobile host becomes IP capable enabling access to/from any other device. The access session remains active at all times as long as the mobile host remains attached to the serving network.

An invocation of a service session by the end user

50 [0141] The user can invoke a service session. The call/session control service is one of many services that the user can invoke. The session server at the LSF service layer facilitates the call/session management control activities. At this point network becomes capable of providing basic call/session control services. However, the network is also capable of providing simple to complex services.

[0142] The user is provided with user capabilities and network preferences to use desired services from the serving network or access external services. Based on the user capabilities and network preferences with respect to the type of user, the network configures itself to respond to the user service invocation.

55 [0143] For example, in the management of basic call/session control services, the session server manager is instantiated at the access management layer that provides the user interface for call/session control services. While at the LSF service layer, instance of a session can be created at the accounting server to handle accounting activities for

any service session. Similarly, for any other service, the appropriate session manager can be instantiated to respond to that specific desired service. The application servers are configured at the LSF service layer.

[0144] This allows the ability to keep access relevant activities coupled with the access dependent service layers, and policy decision making activities at the access independent layers. Also, this allows flexibility to provide mixture of independent services and add new services.

Facilitating network resources to establish point to point or point to multi-point virtual connection

[0145] Distinction between the call/session control services and other applications/services is emphasized throughout the specification for clarification purposes. The call/session control services are the part of the access management services that facilitate establishing point to point and point to multi-point virtual connections.

[0146] **Access session establishment** - The mobile host establishes point of attachment with the serving network. The mobile hosts on power up or during idle state periodically sends registration or location update request to the serving network. The access interface layer components facilitate an air link communication with the mobile host. Upon receiving registration request, AIL distributes it to an access management server component within the AML. The access management server consists of many functions. They are identified in figure 8. They are access, termination and paging functions. These functions have independent functional role and can be separated in different servers if network capacity demands. In this section when access management server is referenced implies an access function of the access management server. The AIL distributes signaling information to the appropriate servers depending on the type of signaling. Optionally, such distribution can be implemented at the AML.

[0147] Now referring to figure 9, the access management layer processes the registration request 900. The domain database 902 within the AML provides the local decision point to the AML components to make primary decisions. The access management server 904 checks with the domain database 902. If the mobile host 906 is already registered, mobile host's current location is updated. If the mobile host 906 is not active within this domain, the access management server sends REGISTER request to the LSF service layer component - mobility manager 908. A SIP message, REGISTER is shown for examples that access management server sends to the mobility manager 908. It includes MIN or "user at domain" location information that identifies cell information.

[0148] Although the activities performed by the mobility manager 908 will not be described in great detail, a brief outcome of this activity is described here. This is the first step in establishing an access session between the mobile host and the serving network. The mobility manager 908 receives the REGISTER message. This indicates that the subscriber needs to be authenticated for access and authorized for the requested services. The mobility manager performs this task with the help of other LSF service layer components such as AAA+, directory services, DHCP, and policy server. If the mobile host is active within the regional serving domain, the LSF service layer components provide the service functions. I.e., an authentication is done through the local AAA server, an IP address assignment through the DHCP that is suitable to the AML domain, and subscriber's default profile is updated at the AML domain database as well as at the regional domain.

[0149] Once the authentication and authorization process is complete, it is assumed that the RAN is authorized to provide access to the mobile host. Now referring to figure 10, first, the access management server 904 interacts with the RF management server 1000. The access management server 904 instructs the RF management server 1000 to assign a traffic channel. The RF management server 1000 interacts with the access interface layer components and facilitates the sending of appropriate air link messages to the mobile host. The RF management server 1000 notifies the access management server 904 once the mobile host 906 establishes the traffic channel. At this time, data link connectivity is achieved between the mobile host and AIL. Second step is to establish PPP connection between the layer 2 of the mobile host and the connection management server 1002.

[0150] The access management server 904 then starts to interact with the connection management server 1002. First, it establishes the co-relation between traffic channel and assigned IP address at the connection management server 1002. Now referring to figure 11, the access management server 1002 handshakes configure/response layer 2 PPP connection messages with the layer 2 of the mobile host through the assigned IP address at the connection management server 1002. At the mobile host 906, layer 2 establishes an IP address service point link with the layer 3 (IP layer). During this handshake, the mobile host 906 accepts the network assigned IP address or provides a desired permanent IP address instead. In case of the latter, the access management server 904 reconfigures the connection management with a new IP address and also updates the appropriate hierarchical databases.

[0151] At this point, an access session is established between the mobile host 906 and the session server 1200 at the serving network as illustrated in figure 12. The application layer at the mobile host 906 becomes IP capable and can access any IP addressable device. The air link at the layer 2 is in the active mode. This link remains active for a pre-determined time that is based on the MAC layer specification. With no activity on air link, active status of this link changes to standby mode, and later goes to the dormant mode and then the traffic channel gets released. However, the established access session at the access management service layer remains active. This access session remains

active until association of the mobile host is removed or deleted at the access management layer. When any data activity happens, either from the mobile host or from the access network, the air link turns from dormant mode to the active mode.

5 Invocation of service session

[0152] Now turning to figure 13, once the mobile host 906 establishes point of attachment at the session server 1200 within the serving network, the mobile host 906 becomes capable to invoke any services. The mobile host 906 can access any IP addressable device. The serving network can help provide locally or globally available services. The serving network becomes smarter and configured to provide services to the user. The default parameters are configured at the local decision points at appropriate domain levels.

[0153] At this time the network is capable to provide basic services. However, the network is capable and flexible enough to provide more complex services. A brief discussion is provided here for reference and will be explored later.

[0154] The serving network provides user capabilities and network preferences to the user. The user capabilities were determined during access session establishment as a result of executing subscriber management services. The network preferences based on network capabilities are pushed to the mobile client 906. Such preferences may include a choice of invoking different type of call/session control services (voice, data, multi-media, etc.) or value added services (Intranet services, location-based services, etc.). More over, the serving network can provide a choice to the mobile host of using the serving network as an ISP provider, or for other possible options. Some of these options are illustrated on screens 1300 and 1302 in figure 13.

Establishment of transport session

[0155] Based on the type of service session invoked, the service session manager (please refer to discussion on service session manager) notifies the connection management function to establish a virtual packet channel path. The connection session manager is instantiated by the connection management function that establishes appropriate network resources to establish requested transport session. The connection management function isolates activities from the call/session control activities. For example, it hides the underlying network topology and supports the inter-working between network layers. Based on the quality of service requirement (which is discussed below), the connection management function facilitates establishment of a path ranging from no packet control to fully dedicated virtual packet channel path. It may use different techniques to achieve the required quality of service. These techniques may include use of MPLS, RTP/RTCP, RSVP as well as other schemes. The quality of service requirements may include the following: bandwidth reservation for a data path (possible use of RSVP); end-to-end latency guarantees through the optimized IP network (possible use of MPLS); network infrastructure selection such as IP or ATM backbone (Layer 1 & 2 selection); protocol selection such as MPLS, RTP/RTCP, RSVP (based on quality of service requirements); and acceptability of loss of data (possibly establish limits on acceptable vs. unacceptable loss based on type of transport session established, such as voice, audio, video, etc.)

Call/Session procedures

[0156] The call flow procedure described here uses several scenarios to outline involvement of access function. However, certain assumptions are identified in the following paragraphs.

[0157] The Mobile host should be IP capable. For example, once the mobile host is attached to a wireless access system, the mobile host can reach any IP addressable device, server or end-user directly and transparently through the network. Also, any external user or device can reach the mobile host transparently through the network.

[0158] The mobile host can seek network services for call/session establishment or dynamic change in resource allocation using standard application protocol such as SIP or RSVP.

[0159] The RAN is IP capable. Particularly, the service components within the RAN; AIL and AML are IP capable. The PPP link is established between the mobile host and connection management component of the AML. The router between the AIL and AML will arbitrate the signaling and traffic packets before forwarding to the pre-configured IP devices of the AML components. This arbitration can be done at the AIL or at the AML depending on the choice of implementation.

[0160] The functions of the AML components are distributed based on the required function. Such functions include access, termination, handoff (location tracking), paging, power control, RF management (resource control), configuration management, and connection management. Also, local domain database for local aspects is used. It provides subscriber dependant data and local policy decision parameters for system dependant data. Alternative to these local aspects, global aspect entities such as AAA+ server and Policy Decision Point (PDP) can be accessed from the core network respectively.

[0161] The AML components require assuming responsibility for the end-user as a User Agent Client and User Agent Server in an ingress and egress direction respectively.

[0162] The AML component interfaces with the core network when necessary. The core network components provide either redirect server function or value added service function to the access function.

Call/session general overview

[0163] The AML service components and the session server are the main network components that play a significant role in call/session management. The AML components are the edge components through which a mobile host in an area accesses the core network for Intranet services or external network for third-party network services or publicly available Internet services.

[0164] Thus, the AML components provide the access function. The access function establishes the functionality and the context needed to grant and support the user in accessing NGWN - Wireless Internet services. The functionality of access management server component within the AML takes the role of user agent in the network domain. Please refer to discussion on each service component.

[0165] The session server provides the call/session service function. The session server provides services to the user agent in establishing functionality and context involved in the negotiations of parties, selection of functional protocol components, configuration and QoS to be associated to the execution of a service. These services are unlike the call model services that facilitate in establishing connection-less or connection oriented call/session. Thus, the session server receives a request from the user agent and satisfies the service need. Upon access initiation or registration, the access management server component of the AML takes the role of user agent on behalf of the mobile host and interacts with the session server in establishing the requested need or service. Upon establishment of an access, appropriate network configuration takes place to serve the mobile host for its default services and network capabilities. In the process, the session service manager is instantiated that interfaces with the mobile host that satisfy the service request such as dynamic change in QoS. Please refer to the section discussing the session server.

[0166] The architecture vision is such that service requests will be facilitated appropriately by the AML components. The service session manager and transport session manager is instantiated by the access management server during access session establishment. These components provide the interface point and satisfy the end users' need and requests.

[0167] Upon terminal registration (e.g. at power up), the mobile host gets control of the radio channel and engage with a specific serving RAN in an area. The mobile hosts send registration messages to the RAN that appears at the associated access management service components. For an example, in case of a CDMA technology, a network layer IS-95 origination message is received from the mobile host to the network access interface. The AIL sends this message to the associated AML using HDLC protocol or simply in IP packets using Ethernet. The signaling IP packets are received at the edge router between AIL and AML. This router arbitrates the type of message and distributes to the appropriate AML components such as access management server, power control server, or handoff server. It is assumed that the IP security is established between AIL and associated AML, and also between identified network layers. The signaling arbitrator is configured with the appropriate IP addresses of the AML components and core network components. Thus, access related messages will be forwarded to the access management server, handoff and mobility related messages will be forwarded to the handoff server, while power control related messages to the power control server, and so on. The data packets will be distributed to the connection management server.

Exemplary Functional Component Interaction Sequence Flow

[0168] Although the functions of related service components and their interactions are described earlier, figure 14 provides functional component interaction sequence flow. The following paragraphs describe a general overview for these sequences.

[0169] Sequence 1 is described as when the network layer (L3) of the mobile host sends the registration request (e.g. at the power up) to establish a point of presence at the serving network. The access function of the AML service layer receives this request.

[0170] Sequence 2 comes into play when the access function at the AML service layer communicates with the mobility manager at the LSF service layer. The mobility manager performs several functions for which it may communicate with other functional components at the LSF service layer and/or with NSF service layer in order to provide subscriber management services. In this process the mobility manager may communicate back to the mobile host through the AML service layer to authenticate the mobile host.

[0171] Sequence 3 gets traversed when registration is completed, the mobility manager facilitates to download information such as a subset of user specific default parameters and allowed service options to the AML domain database. Such information provides local decision point to expedite future service invocation procedures if necessary.

[0172] The access function at the AML service layer communicates with the RF management server in sequence step 4. For simplicity, the RF management server is not shown in this figure. The RF management server performs procedure to assign traffic channel.

[0173] Sequence 5 designates informing the access function upon completion of traffic channel assignment.

5 [0174] The access function of the AML service layer communicates with the connection management server in sequence 6. It facilitates to establish relation between traffic channel and assigned IP address. Then, the access function negotiate with the mobile host at the layer 2 through the connection management server of the AML service layer to establish PPP connection and IP address selection. The mobile host may accept the network provided IP address or mobile host may provide its permanent IP address to use.

10 [0175] The mobile host communicates back to the access function of the AML service layer in sequence 7 indicating accepted IP address assignment. The access function facilitates the necessary changes relative to the selected IP address at the AML domain and/or at the LSF service layer database.

[0176] Upon establishing PPP link between the mobile host and the connection management server, the access function at the AML service layer communicates to the session server in sequence 8 to download necessary information to the mobile host.

15 [0177] The session server downloads necessary information to the mobile host in sequence 9. The information includes: end user's capabilities that derived as a result of providing subscriber management services during access session establishment, and network preferred preferences for which network is configured to provide optimum service. Also, the session server communicates with the connection management to provision default bandwidth and required quality of service requirement corresponding to the end user.

20 [0178] The sequence 10 indicates the service invocation by the mobile host. The sequence 10' (10 prime) indicates an service invocation (e.g. origination) from the network layer of the mobile host. In this case, with respect to SIP, the access function at the AML service layer provides the function similar to the user agent client (UAC). The sequence 10 indicates an service invocation from the application layer of the mobile host. In this case, with respect to SIP, the mobile host application layer provides the function similar to the UAC. Based on the end user invocation of specific use of service, the mobile host has multiple options: it can reach directly to the callee (destination end user, i.e., e.g. user agent server in SIP context); it can reach to the other domain network. In SIP context, it can reach to a user agent server proxy that can terminate to the appropriate user agent server; or it can reach to the serving network's provided appropriate protocol server. In SIP context, it can reach to the user agent client proxy. The user agent client proxy can facilitate the further action to provide necessary resources and forward service session establishment request to the callee.

30 [0179] If the user chooses to use network provided appropriate protocol servers, then the appropriate protocol server receives the service session invocation request in sequence 10A and 10'A. The protocol server communicates with the session server that arbitrates to the appropriate controlling entity. For an example, in SIP context, the user agent client proxy will communicate with the Redirect server. Likewise, in H.323 context, the H.323 gateway will communicate with the gatekeeper (GK). The other GW performs similar functionality provided by the user agent client proxy in SIP context or H.323 gateway in H.323 context. Such gateways may include PSTN gateway, and similar others.

[0180] Sequence 10B, 10' B is the response from the session server. The session server provides information that required to appropriately forward the service session request to the callee or to the destination.

40 [0181] Sequence 10C, 10' C indicates when the session server at the LSF service layer or the access function at the AML service layer communicates with the connection management server to allocate allowed bandwidth and provide selected quality of service for the transport session. Such allocation will be committed upon completion of the signaling negotiation between end parties.

[0182] Sequence 10D, 10'D is the forwarding request go out to the appropriate destination.

45 [0183] Sequence 11 designates when the forwarding request arrives at the user agent server proxy in SIP context, or at the H.323 gateway in H.323 context, then, such entities performs necessary functions to validate for admission control, identifying location of the end user and forwards request to the end user. Similarly, the other gateway will provide the same functions.

50 Protocol choices

[0184] The list of network preferred protocol preferences could be provided to the mobile host during access session establishment. The access management functions at the AML and the session server at the LSF network layer facilitate the end user with varieties of options based on the type of user's capability, subscribed options, and network preferred protocol preferences. Based on the choice of user invocation, appropriate protocol servers are accessed to establish service session. If the end user is not capable of selecting protocol options, the end user can access the access management functions. This is also a traditional way of handling request from the mobile host. The access management functions interact with the session server to determine the appropriate protocol function and facilitate the selected

capability components that can establish the service session. The request is hand over to the appropriate server to establish service session.

[0185] This scheme provides the support of any protocol. For an example, the SIP (SIP RFC 2543) and H.225 (H.225 - Call Signaling Protocols and Media Stream Packetization for Packet Based Multimedia Communications Systems) & H.245 (H.245 - Control Protocol for Multimedia Communication) protocol stack can be supported independently and transparently. Also, legacy protocols can be supported in the same fashion.

Wireless access scenarios

[0186] Two paths are illustrated in figure 15. The first facilitates control of the air 1500 and the virtual packet channel path 1502. The second facilitates signaling interactions 1504 with the core network to establish session and allocation of local resources. The two distinct channels through which traffic data flows are identified in the following paragraphs.

One through the air link and another through the virtual packet channel

[0187] The virtual packet channel 1502 can be established through all the routers along the data path using RSVP (following PATH - RESV signaling sequence between routers). Thus, the control of the virtual link and dynamic bandwidth changes can be obtained by using RSVP processed at each router along the data path. However, the control of the air link is not trivial. This is because of two reasons. First, the data transformation at the connection management 1506 does not distinguish data from signaling and thus, does not process the signaling protocol. The RSVP signaling is merely transported through the wireless access point to the end terminal. Thus, it becomes the end terminal's responsibility to interact with the access point to allocate or modify the bandwidth necessary for the air path. This leads to the second point where bandwidth adjustment requires a unique signaling handshake between the IP Mobile host 1508 and the AIL-AML interface 1510.

Control of session establishment and resource allocation

[0188] Within the wireless access point, the client agent for the end user performs several functions. Some of these functions include interactions with the core network 1512. The user agent (client 1514 or server 1516) performs the role of policy enforcement while the core network 1512 performs the role of policymaking decisions. Depending on the implementation choice, interactions related to the policy may be performed locally or at the core network 1512. It may be practical to distribute default parameters and the subscribers' allowed resource allocation at the time of registration to the local domain database. In this case the policy enforcement function that is a part of the user agent (access management server), performs decisions based on the local decision point (LDP) 1518.

[0189] IP capable end terminals 1520 can communicate with each other transparently. However, the wireless access point plays an important role in establishing the air link path. An intervention at the wireless access point can occur several times during the communication. These scenarios are identified in the following paragraphs.

Scenario 1

[0190] As shown in figure 16, the IP capable end terminals 1508, 1520 are in active state. Assume terminal A 1508 is attached to the wireless access side. Terminal B 1520 is somewhere else on the Internet. Terminal B 1520 sends an INVITE message directly to the terminal A 1508 using the currently used call ID to modify an active call/session with different quality of service parameters than what is included in the SDP. Terminal A 1508 needs to send a request 1600 to the access system to modify the established air link 1500.

Scenario 2

[0191] Figure 17 shows the case of a termination. When the distant client 1520 sends a message 1700, for example, an INVITE message, to the AML 1510, the message ends up at the user agent proxy server. The policy enforcement points and call admission control functions take place at the user agent proxy server. The user agent proxy server may need to access the subscriber related or the system level policy decision database. Such databases can be located locally or at some central location. The subscriber dependent database can be accessed through the local database 1518 (domain dB) for validity, profile check and current cell location if available or may be accessed through AAA server centrally located within the core network. Similarly, system level policy decisions such as allocation of subscriber requested bandwidth with respect to the availability can be checked by the proxy server by accessing local policy decision database or globally located database.

Scenario 3

[0192] Figure 18 shows the call/session invocation request scenario. Though an IP mobile host 1508 is capable of establishing a call/session with another external device 1520 transparently without interaction of AML 1510, it is possible that in many cases the IP mobile host 1508 may request the AML 1510 to establish such a call/session. An example of such cases may include where a mobile host 1508 wants to establish a multicast call/session; in that case, it would request the AML 1510 to establish such a session. This is important mainly due to the bandwidth limitation of the air link 1500. The AML 1510 would facilitate the multicast of packets to as many sessions as needed. Another example is where trigger based services are incorporated that allow mobiles to invoke pre-established value added services offered by a local service provider or a local Intranet.

Scenario 4

[0193] Figure 19 shows the power up registration scenario. The power up is one case when the AML 1510 is accessed to establish an air link 1500 and establish access session. Once the air link 1500 is established, the mobile host 1508 can stay in active or dormant state. In any of these cases, the subscribers' profile is kept in a local database (domain dB) 1518. QoS policy and policy enforcement points are distributed in the access (user agent client) function for ingress and terminating user agent proxy for egress activities. Depending on the QoS requested, that include bandwidth requirements at the default level.

Scenario 5

[0194] Figure 20 shows the scenario where default parameters are used and no intervention is required. That means the mobile user 1508 can establish a session with an external user 1520 using default QoS parameters provisioned during access session establishment. In egress, the user agent proxy server will use default parameters to establish call/session with the user 1508 within the domain of AML 1510.

[0195] Figure 21 illustrates an example implementation of the architecture of the preferred embodiment. As shown, one access management layer 2100 can have one or more access interface layers 2102 and one local service function layer 2104 can have one or more access management layer 2100. In addition, local service function layer 2106 is also depicted with one or more access management layers 2108, which in turn have one or more access interface layers 2110. Additionally, the local service function layers 2104 and 2106 are shown to be connected to a network service function layer 2112 through either a LSF firewall 2114, the public Internet 2116 and a NSF firewall 2118, or through a private link 2120. The LSFs 2104, 2106 would use the private link 2120 if the NSF belonged to the same service provider and would use the firewalls 2114, 2118 if the NSF belonged to a different service provider.

[0196] Moreover, NSF 2122 is connected to NSF 2112 through a private link 2124, through a service level agreement link 2126 or through another NSF firewall 2128, the public Internet 2116 and the original NSF firewall 2118. Similarly to the LSF/NSF connections, the two NSFs 2112, 2122 would use the private link 2124 if the two NSFs belonged to the same service provider, the service level agreement link 2126 if the two NSFs had a service level agreement and the firewalls 2128, 2118 if the two NSFs belonged to two different service providers.

[0197] In addition, LSFs 2130, 2132, private link 2134, LSF firewall 2136, access management layers 2138, 2142, and access interface layers 2140, 2144 are depicted in the same format as the other components on the right side of figure 21 for simplicity purposes. However, the network could be arranged in countless ways and still withhold the relationships described above.

Conclusion

[0198] It is understood that several modifications, changes and substitutions are intended in the foregoing disclosure and in some instances some features of the invention will be employed without a corresponding use of other features. Accordingly, it is appropriate that the appended claims be construed broadly and in a manner consistent with the scope of the invention.

Appendix A: Service layer functional components

5 This section elaborates some of the functional components that are distributed in network service layers. The definitions given here are of generic. However, relevant details to the call/session management services are described in the specification.

10 **Policy management & Policy enforce server** - The policy management server defines business and service concerns, and more precisely, policies for users and network devices. It distributes policies to the network devices to enforce the policies defined by the network administrator. It provides policy decisions to control network behavior provided to the user. The policy enforcers are respectively at the lower layer to the policy management at appropriate network devices. These devices communicate with the policy management server using COPS protocol. The policy relevant information can be distributed at the appropriate hierarchy network layer in order to expedite the real time critical decisions.

25 **Authentication server** - The authentication server is the core network component. The mobility manager facilitates the authentication process for the mobile host. The authentication server is reachable through the AAA+ server that provides the common protocol for Authentication, Authorization, and Accounting activities. The authentication function is provided based on the digital certificates/signatures.

35 **Directory server** - The directory server stores the user service profile and policy in a database. The directory server communicates with other network components such as policy management server using LDAP protocol. The directory server uses Directory Enabled Networking (DEN) scheme. The DEN scheme takes an advantage of information already stored in directories.

45 **DHCP** - In an IP centric NGWN – Wireless Internet, a mobile host must be initially assigned a specific IP address that is appropriate to the network domain to which the mobile host is attached. If the mobile host moves to a new network domain, a new IP address must be assigned. The Dynamic Host Configuration Protocol provides such mechanism through which an IP address is allocated to the attached mobile host. The mobility manager component of the LSF service layer facilitates this procedure.

55 **DNS – NAI DNS** - The Domain Name System is the software that allows name to

number mapping. The name richweb is the 47.161.113.52 and vice versa. This is achieved through the DNS. The DNS is a hierarchy. There are small number of root domain name servers that are responsible for tracking the top-level domains and who is under them. The root domain servers between them know about all the people who have name servers that are authoritative for domains under the root. In the NGWN – Wireless Internet the DNS hierarchy is established based on the user's current location.

Mobility Manager - The mobility manager functional component is the part of the core network component. It facilitates to provide subscribers' management services during the access session establishment between the mobile host and the serving network. It also facilitates the inter-domain handoff activities.

Access Accounting server - The access accounting server is the core network component. The session server that facilitates to configure service session invocation, that also facilitates the instance for that service session at the accounting server to record the usage activities. The access accounting server is reachable through the AAA+ server that provides the common protocol for Authentication, Authorization, and Accounting activities.

AAA+ - The AAA+ server provides the common protocol access to the network clients to access Authentication, Authorization, and Accounting servers. Currently, the DIAMETER and RADIUS protocols are under evaluation for the AAA+ server access.

Network management - The network management functions at the different network layer hierarchy provide appropriate management functions. The management functions take care of business and service oriented concerns. Ideally these functions can be distributed to the core network for business decision (policy management) and service session related activities and at the AML for the network resources and transport session related activities. These functions include fault management, configuration management, accounting management performance management, and security management.

Call Server - The call server is the core network component. It takes the role of media gateway controller. It controls signaling gateway and media gateway components that interface with the PSTN.

Session server - Please refer to text above describing session server.

Location tracking - The location tracking is the part of the access management layer component. It keeps track of the mobile host's location movement activities in the WAG domain. It facilitates the handoff activities between cells within the WAG domain. Also, it facilitates in inter-WAG domain handoff activities. The neighboring WAG domain information can be exchanged directly. It interacts with resource manager for the purpose of maintaining radio link and Care Of Address (COA) relationship. Also it interacts with the domain database server to update the end-user's location.

Power Control function - Power control function handles all power control related activities. It performs the necessary algorithm to manipulate special situations, which may occur due to interference or adjustment during the start of a call. It interacts with resource manager for the purpose of maintaining power level of the radio link.

Connection management server - The connection management server handles activities to establish virtual packet channel through the serving network. It gets instructions from the access management server. For each service session created, a transport session manager is also instantiated. The transport session keeps track of usage activities based on the instruction provided either per packet, per byte, time in active session, or flat time. It facilitates to establish point to point or point to multi-point transport session.

Access management server - Please refer to text above for access and termination-paging function.

RF management - The RF management server is the access management layer component. It facilitates the controlling function for the radio dependent activities. It interfaces with the access management layer components. Also, it interfaces with the access interface layer components.

Appendix B: Core network functions

The LSF/NSF network layer consists of core functional service components required for telecommunication network. This section identifies the major core network functionality expected from the LSF/NSF network layer functional service components shown in Figure 2. Some of the core network functions are described in the following paragraphs.

Serving domain specific address assignment.

Policy decision based on subscriber's profile, assigned network preferences, and available network resources.

Network management control function.

Subscriber management services during access session establishment that at least include authentication and authorization.

Providing subscriber's capabilities and network preferences in serving end user.

Configuring appropriate application servers or facilitating functional service components based on the subscriber's default services or invoked services.

Usage data collection and accumulation of network resources and recording.

Handoff activities to support continuous mobility between multiple access points.

Claims

1. A method for a first user to communicate in an Internet Protocol (IP) centric distributed network with a plurality of service layers providing a plurality of functions associated with each of the service layers, the method comprising:
 - accessing the network to establish a point of presence at an access management layer and a core portion of the network and to designate a default amount of bandwidth and a plurality of default setup parameters; invoking service through a session server on the network to establish an amount of network resources requested by the first user; and
 - establishing a transport session to create and manage a connection from the first user to a destination address.
2. The method of claim 1 wherein the plurality of service layers includes a network service function layer.
3. The method of claim 1 wherein the plurality of service layers includes a local service function layer.
4. The method of claim 1 wherein the plurality of service layers includes an access service function layer.
5. The method of claim 3 wherein the local service function layer is independent of a specific access technology used for the first user to communicate to the network.
6. The method of claim 4 wherein the access service function layer accommodates a plurality of technologies used for the first user to communicate to the network.
7. The method of claim 1 wherein the invoking service through the session server includes providing a list of a

plurality of functions available to the first user.

8. The method of claim 7 wherein the plurality of functions available to the first user are based on capabilities of the first user and a plurality of network preferences.
9. The method of claim 8 wherein the session server also provides addressing of any appropriate server to contact for each of the plurality of functions available to the first user.
10. The method of claim 7 wherein the session server contacts an accounting server through an Authorizing, Authentication and Accounting server and initiates an appropriate record of resources committed to the first user.
11. The method of claim 10 wherein the accounting server sends information to an accounting accumulator at the network service layer.
12. The method of claim 10 wherein the session server instructs a connection management server to record usage information according to resources used by the first user.
13. The method of claim 12 wherein the usage information includes at least one of the group consisting of: time used by first user, packets used by first user, flat rate for each access by first user or bytes used by first user.
14. The method of claim 2 wherein the network service layer includes a mobility manager that provides handoff services to the first user when the first user leaves the local service function layer for another local service function layer.
15. The method of claim 3 wherein the local service layer includes a mobility manager that provides handoff services to the first user when the first user leaves an access management layer for another access management layer.
16. The method of claim 3 wherein the access management layer includes a location tracking server that provides handoff services to the first user when the first user leaves a first cell in a first access interface layer for another cell in another access interface layer.
17. The method of claim 1 wherein a session server reserves any quality of service parameters and an amount of bandwidth requested by the first user.
18. The method of claim 1 wherein an access and termination function at an access management layer reserves any quality of service parameters and an amount of bandwidth requested by the first user.
19. The method of claim 1 further including sending communications from an application layer at the first user wherein an user agent client resides at the first user.
20. The method of claim 1 further including sending communications from a layer 3 at the first user wherein an user agent client resides at an access management layer of the access layer.
21. The method of claim 1 further including an user agent server associated for each of a plurality of access interface layer of the access layer.
22. The method of claim 1 further including an user agent server that acts as a gateway by converting incoming protocols of incoming communications to a protocol understood by the first user.
23. The method of claim 1 further including an user agent server that delivers incoming protocols of incoming communications to the first user when the incoming protocol is understood by the first user.
24. The method of claim 1 wherein the session server further provides admission control functions and address resolution to an user agent client and an user agent client proxy at a SIP protocol server.
25. The method of claim 1 wherein the session server further provides admission control functions and address resolution to a H.323 terminal and a H.323 gateway at a H.225 protocol server.
26. The method of claim 1 wherein the network includes a connection management server that can transport commu-

nications on a plurality of backbone infrastructures.

27. The method of claim 1 wherein the network includes a connection management server that can transport communications on a point to point basis.
28. The method of claim 1 wherein the network includes a connection management server that can transport communications on a point to multi-point basis.
29. The method of claim 1 further including providing the requested amount of network resources by utilizing a connection management server that utilizes a plurality of protocols to deliver a requested quality of service for latency.
30. The method of claim 1 further including providing the requested amount of network resources by utilizing a connection management server that utilizes a plurality of protocols to deliver a requested bandwidth.
31. The method of claim 1 further including deciding policy parameters at a core network level.
32. The method of claim 31 further including enforcing policy parameters at an access management level.
33. The method of claim 1 wherein a plurality of access management layer components interact with a network layer of the first user to establish an access session.
34. The method of claim 1 wherein a plurality of access management layer components interact with a plurality of components to bring the mobile host on the traffic channel.
35. The method of claim 1 wherein a plurality of access management layer components interact through a connection management component to establish point to point protocol path that allows the first user to access any other IP capable device through a serving network.
36. The method of claim 1 wherein a plurality of network preferred call/session control services are handled through a plurality of access management components.
37. The method of claim 1 wherein handoff, power control, and paging functions related handshakes with the first user are controlled by a plurality of access management components.
38. The method of claim 1 wherein the first user interacts with a plurality of protocol servers and access management service layer components.
39. The method of claim 38 wherein the plurality of protocol servers and access management service layer components interact with a plurality of components at the local service function layer.
40. The method of claim 1 wherein a plurality of components at a local service function layer provide specific services to a plurality of access management components during establishment of an access session and service session with the first user.
41. The method of claim 1 wherein the accessing includes providing subscriber management and policy decision services for the first user.
42. The method of claim 1 wherein policy decision services are provided for the first user during user session invocation.
43. The method of claim 1 wherein Intranet services are provided to the first user by a local service function layer through specialized application servers.
44. The method of claim 1 wherein the first user interacts with a plurality of global network service components
45. The method of claim 1 wherein the accessing further includes a network service function layer providing services to a local service function layer.
46. The method of claim 1 further including providing subscriber management services during an access session

establishment for the first user.

47. The method of claim 1 further including facilitating publicly available services.

5 48. The method of claim 1 further including facilitating direct home network accesses.

49. A communications network architecture for an Internet Protocol centric wireless network for a first user to communicate to a destination, the network comprising:

10 a plurality of network service function layers within the wireless network;
a first set of a plurality of local service function layers associated with one of the plurality of network service function layers within the wireless network;
a first set of a plurality of access service function layers associated with one of the plurality of local service function layers; and
15 a second set of a plurality of access service function layers associated with a second of the plurality of local service function layers.

50. The communications network of claim 49 wherein at least two of the plurality of network service function layers belong to a first wireless network service provider and are connected through a private link.

20 51. The communications network of claim 49 wherein at least two of the plurality of network service function layers belong to two different wireless network service providers and are connected through a private link governed by a service level agreement.

25 52. The communications network of claim 49 wherein at least two of the plurality of network service function layers belong to two different wireless network service providers and are connected through a public link.

30 53. The communications network of claim 49 wherein the network service function layer includes a mobility manager that manages a handoff when the first user leaves one of the plurality of access service function layers and enters another of the plurality of access service function layers.

54. The communications network of claim 49 wherein at least one of the plurality of network service function layers and at least one of the local service function layers reside in a single entity.

35 55. The communications network of claim 49 wherein the first set of the plurality of local service layers includes a session server

56. The communications network of claim 55 wherein the session server provides a list of a plurality of functions available to the first user.

40 57. The communications network of claim 56 wherein the plurality of functions available to the first user are based on capabilities of the first user and a plurality of network preferences.

45 58. The communications network of claim 56 wherein the session server provides addressing of any appropriate server to contact for each of the plurality of functions available to the first user.

59. The communications network of claim 56 wherein the session server contacts an accounting server through an Authorizing, Authentication and Accounting server and initiates a record of resources committed to the first user.

50 60. The communications network of claim 59 wherein the accounting server sends information to an accounting accumulator at one of the plurality of network service layers.

55 61. The communications network of claim 59 wherein the session server instructs a connection management server at the first set of a plurality of the local service layer to record usage information according to resources used by the first user.

62. The communications network of claim 61 wherein the usage information includes at least one of the group consisting of: time used by first user, packets used by first user flat rate for each access by the first user or bytes used

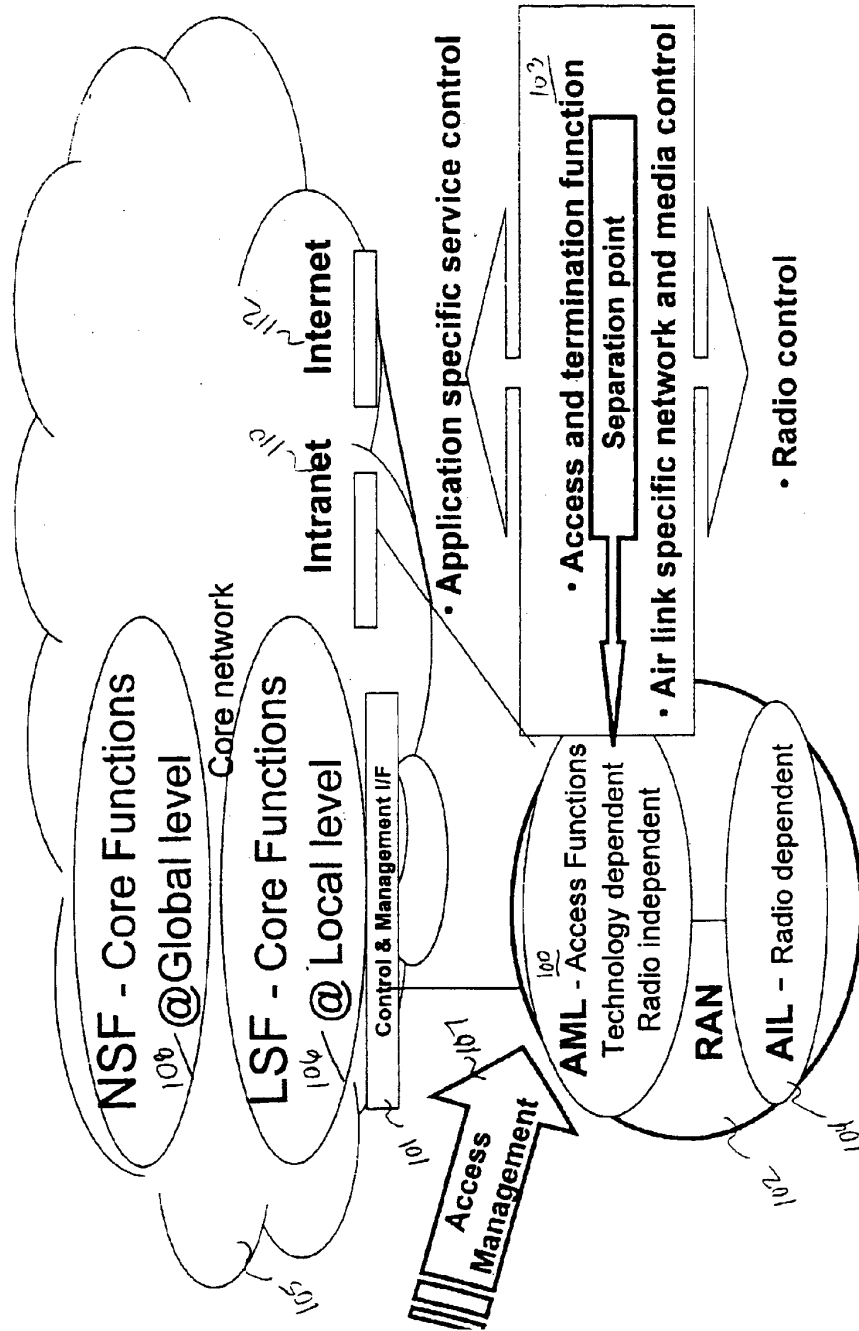
by first user.

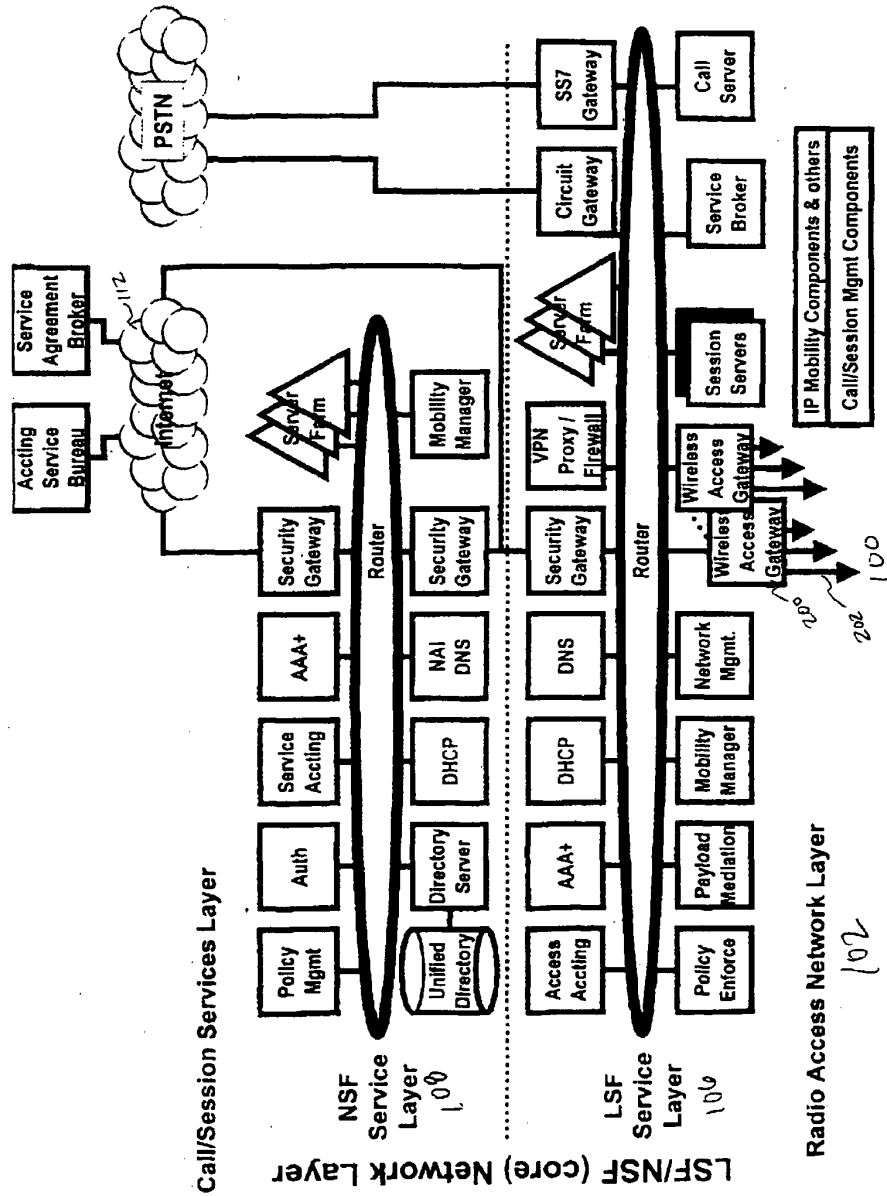
63. The communications network of claim 59 wherein each of the plurality of network service layers includes a mobility manager that provides handoff services to the first user when the first user leaves one of the first set of the plurality of local service function layers for another of the first set of the plurality of local service function layers.
64. The communications network of claim 59 wherein at least one of the plurality of the network service layers includes a mobility manager that provides handoff services to the first user when the first user leaves one of the first set of the plurality of access management layers for another one of the first set of the plurality of access management layers.
65. The communications network of claim 59 wherein the session server reserves any quality of service parameters and an amount of bandwidth requested by the first user.
66. The communications network of claim 59 wherein an access and a termination functions at one of the first set of the plurality of access management layers reserves any quality of service parameters and an amount of bandwidth requested by the first user.
67. The communications network of claim 49 further including an application layer that sends communications from the first user and an user agent client residing at the first user.
68. The communications network of claim 49 further including a layer 3 at the first user that sends communications to the network and an user agent client residing at one of the first set of the plurality of access service function layers.
69. The communications network of claim 49 further including an user agent server associated for each of a plurality of access interface layer at the first set of the plurality of access service function layers.
70. The communications network of claim 69 wherein the user agent server acts as a gateway by converting incoming protocols of incoming communications to a protocol understood by the first user.
71. The communications network of claim 69 wherein the user agent server delivers incoming protocols of incoming communications to the first user when the incoming protocol is understood by the first user.
72. The communications network of claim 59 wherein the session server further provides admission control functions and address resolution to an user agent client and an user agent client proxy at a SIP protocol server.
73. The communications network of claim 59 wherein the session server further provides admission control functions and address resolution to a H.323 terminal and a H.323 gateway at a H.323 protocol server.
74. The communications network of claim 59 further including a connection management server at a access management layer within one of the first set of access service function layers and wherein the connection management server can transport communications on a plurality of backbone infrastructures.
75. The communications network of claim 74 wherein the connection management server can transport communications on a point to point basis.
76. The communications network of claim 74 wherein the connection management server can transport communications on a point to multi-point basis.
77. The communications network of claim 74 wherein the connection management server provides a requested amount of network resources by utilizing a plurality of protocols to deliver a requested quality of service for latency.
78. The communications network of claim 74 wherein the connection management server provides a requested amount of network resources by utilizing a plurality of protocols to deliver a requested bandwidth.
79. The communications network of claim 49 further including a core network lever including the plurality of network service function layers and the first set of the plurality of local service function layers and wherein the core network layer decides policy parameters.

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80. The communications network of claim 49 further including an access management layer within the first set of access service function layers and wherein the access management layer enforces policy parameters.
- 5 81. A communications network architecture for an Internet Protocol centric wireless network for a first user to communicate to a destination, the architecture comprising:
- a network service function layer within the wireless network, wherein the network service layer comprises a plurality of interconnected servers including:
- 10 a policy management server;
an authorization server;
a service accounting server;
an authentication, authorization and accounting server;
an unified directory within a directory server;
15 a security gateway; and
a mobility manager;
- a local service function layer communicably linked with the network service function layer within the wireless network, wherein the local service function layer comprises a plurality of interconnected servers including:
- 20 an access accounting server;
an authentication, authorization and accounting server;
a security gateway;
a policy enforcement server;
25 a mobility manager;
a network management server; and
a wireless gateway;
- an access management layer communicably linked with the local service function layer, wherein the access management layer comprises a plurality of interconnected servers including:
- 30 a location tracking server;
a connection management server;
a plurality of protocol servers;
35 a RF management server which includes power control, traffic control and channel assignment;
an access management server includes access, termination and paging;
a domain database server which provides a local decision point to expedite service invocation for the first user;
a policy enforcement server;
40 a network management server; and
a resource management server; and
- an access interface layer communicably linked with the access management layer, wherein the access interface layer comprises a plurality of interconnected servers including:
- 45 a channel management server;
a policy enforcement server;
an administration and maintenance server; and
a radio frequency server.
- 50 82. The communications network architecture of claim 81 wherein the access management layer provides policy enforcement.
- 55 83. The communications network architecture of claim 81 wherein the local service layer provides policy decision functions.

FIGURE 1





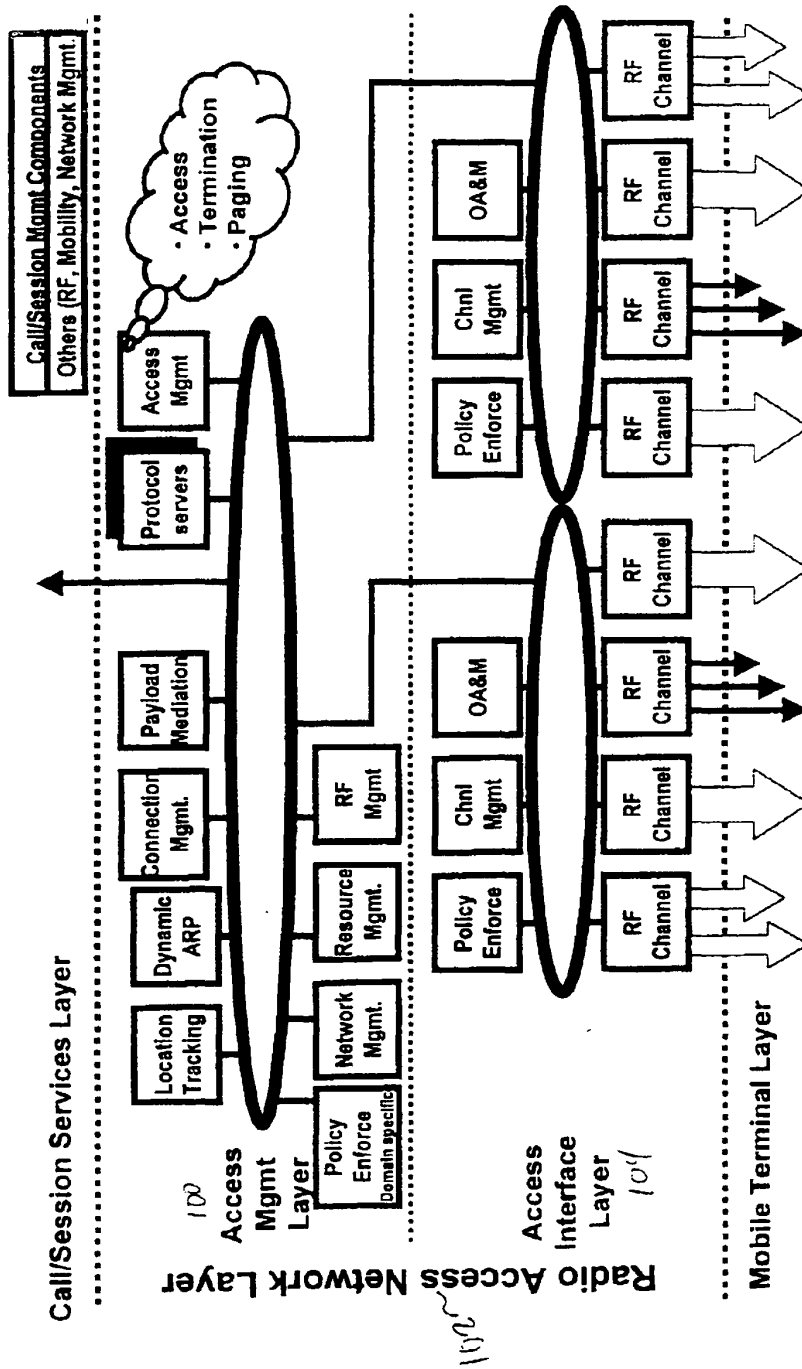


FIGURE 3

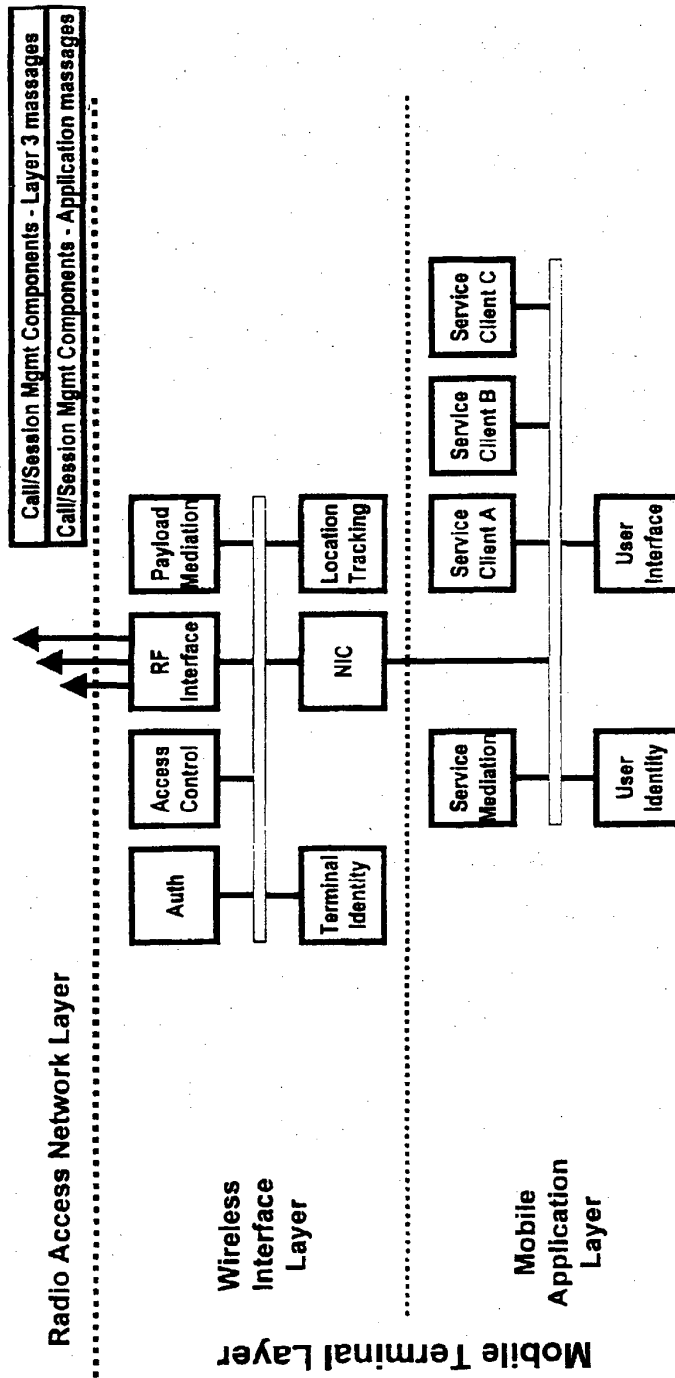


FIGURE 4

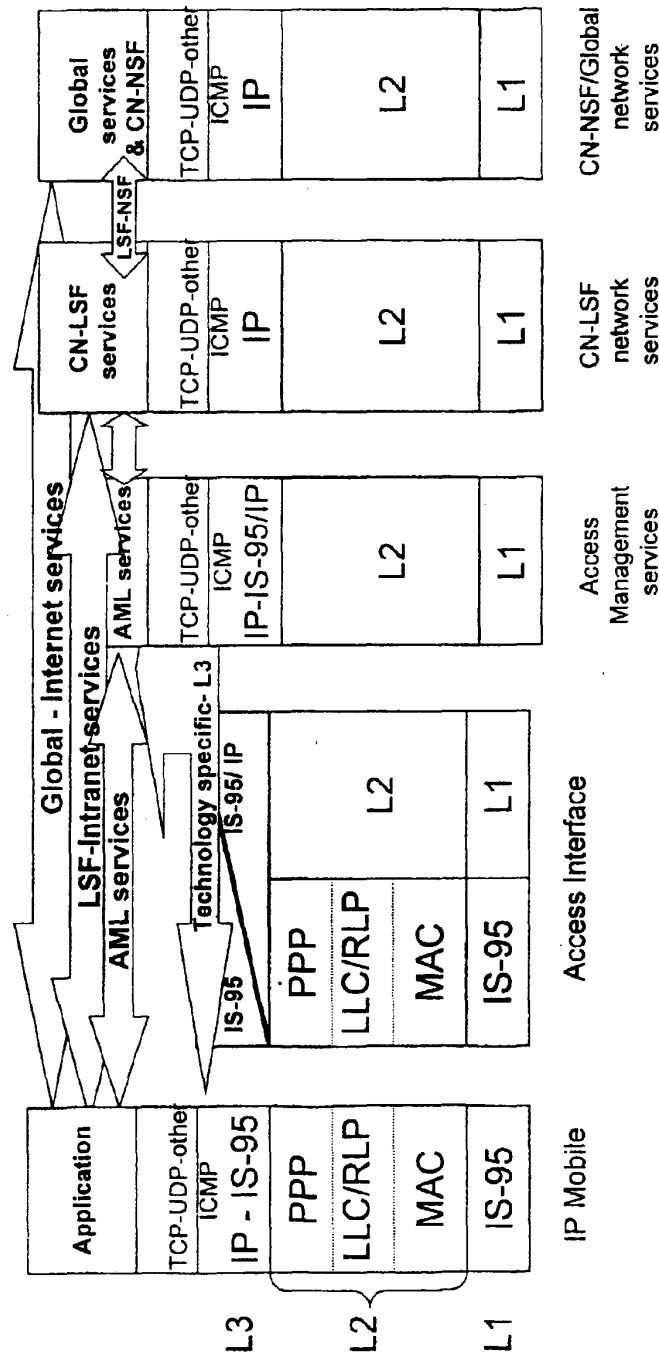


FIG. 14

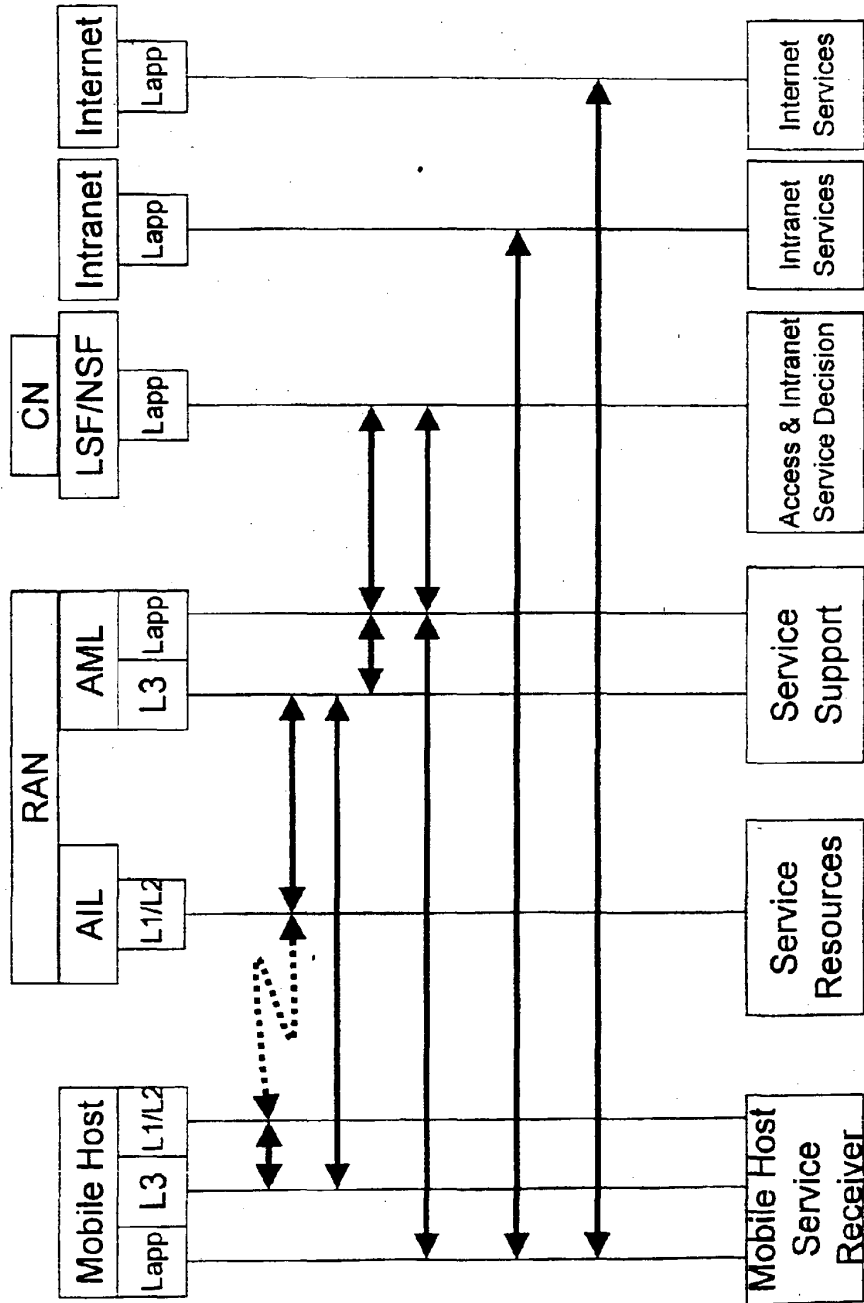


Figure 6

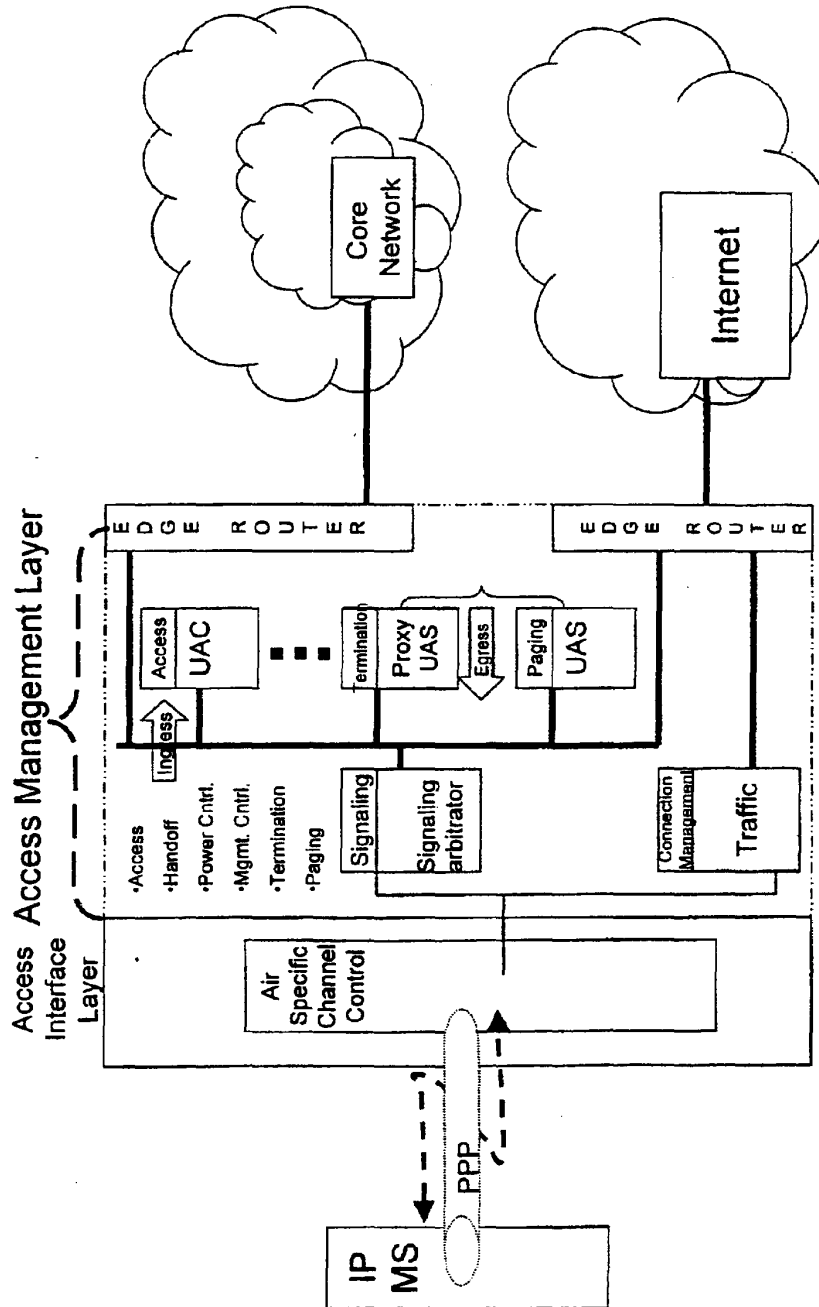


FIGURE 7

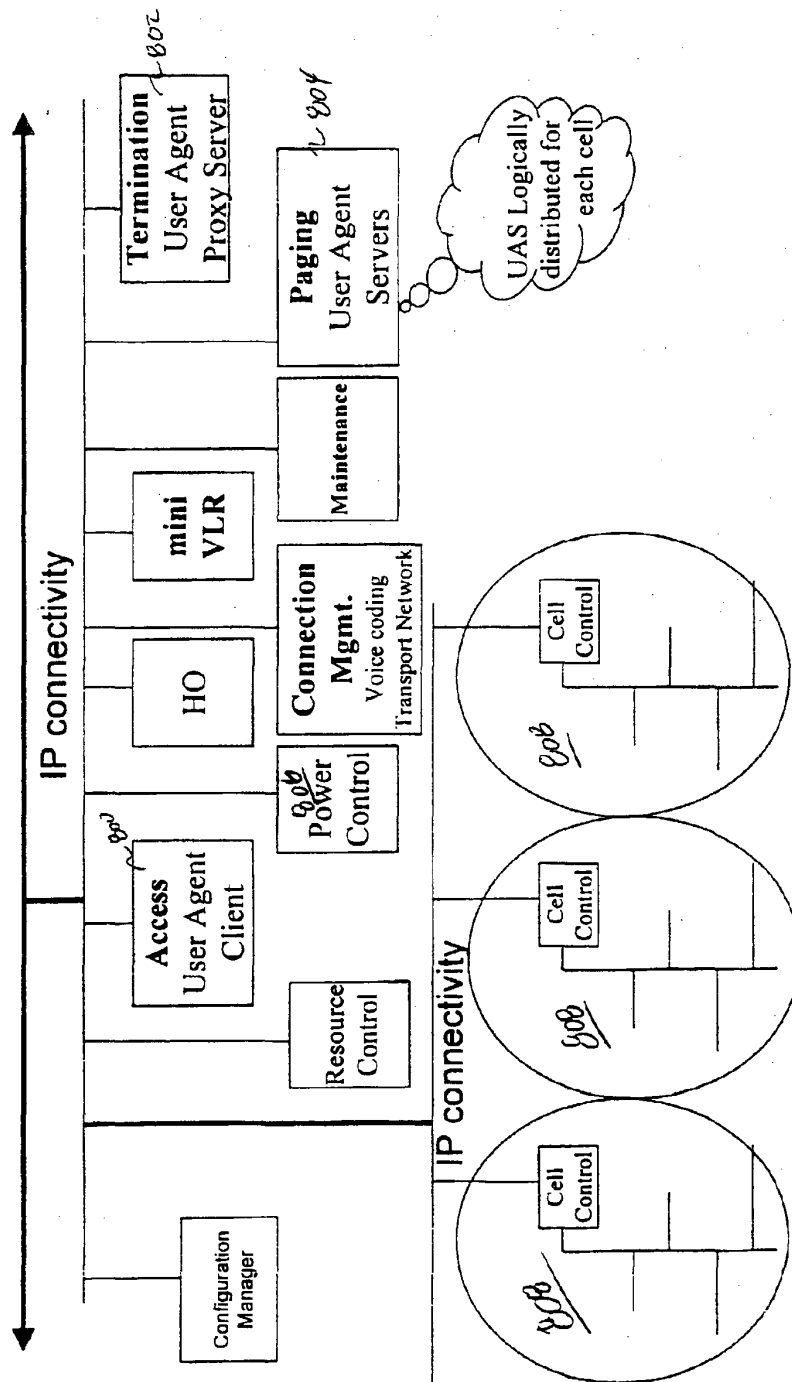


Figure 8

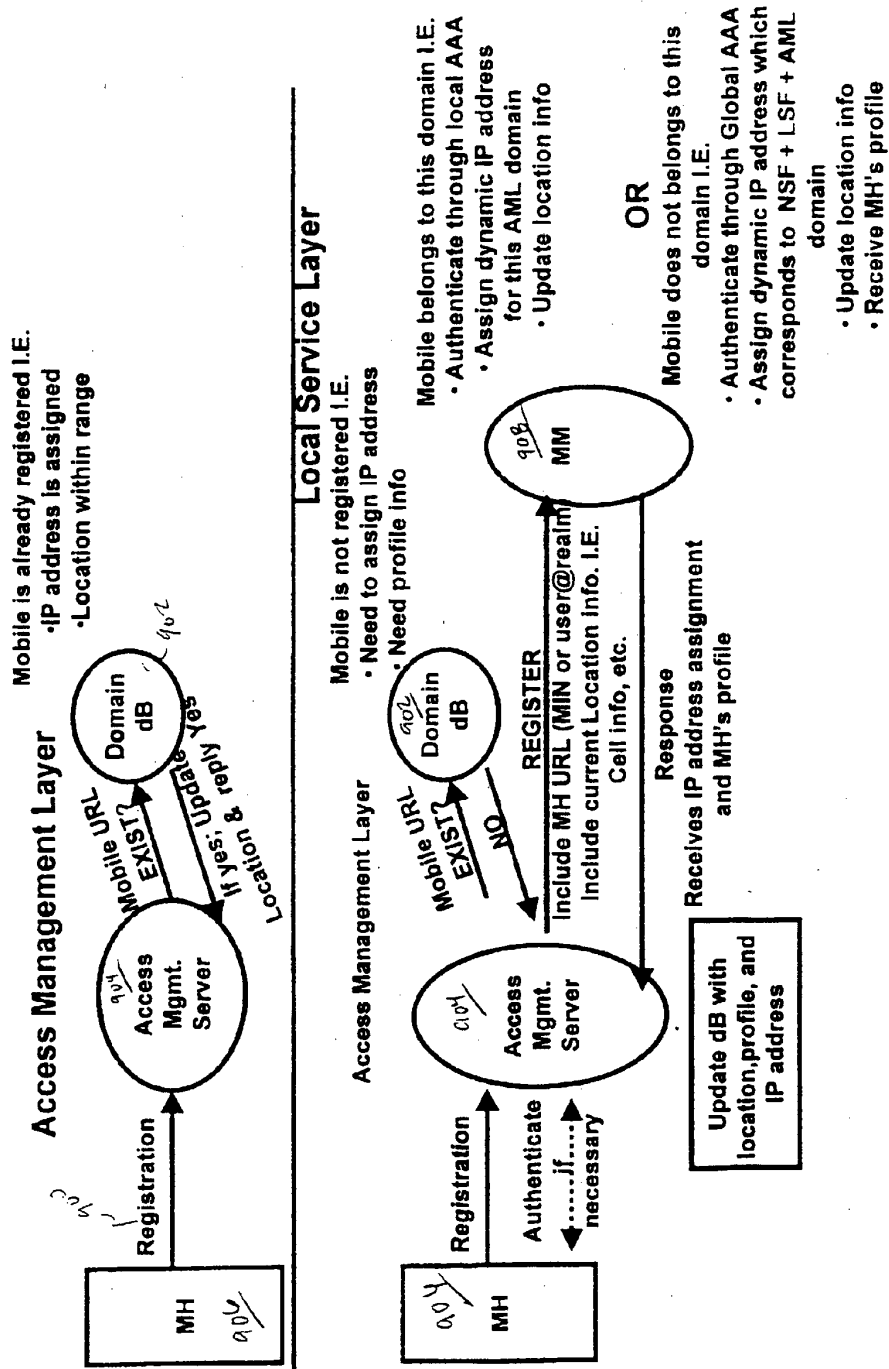


Figure 9

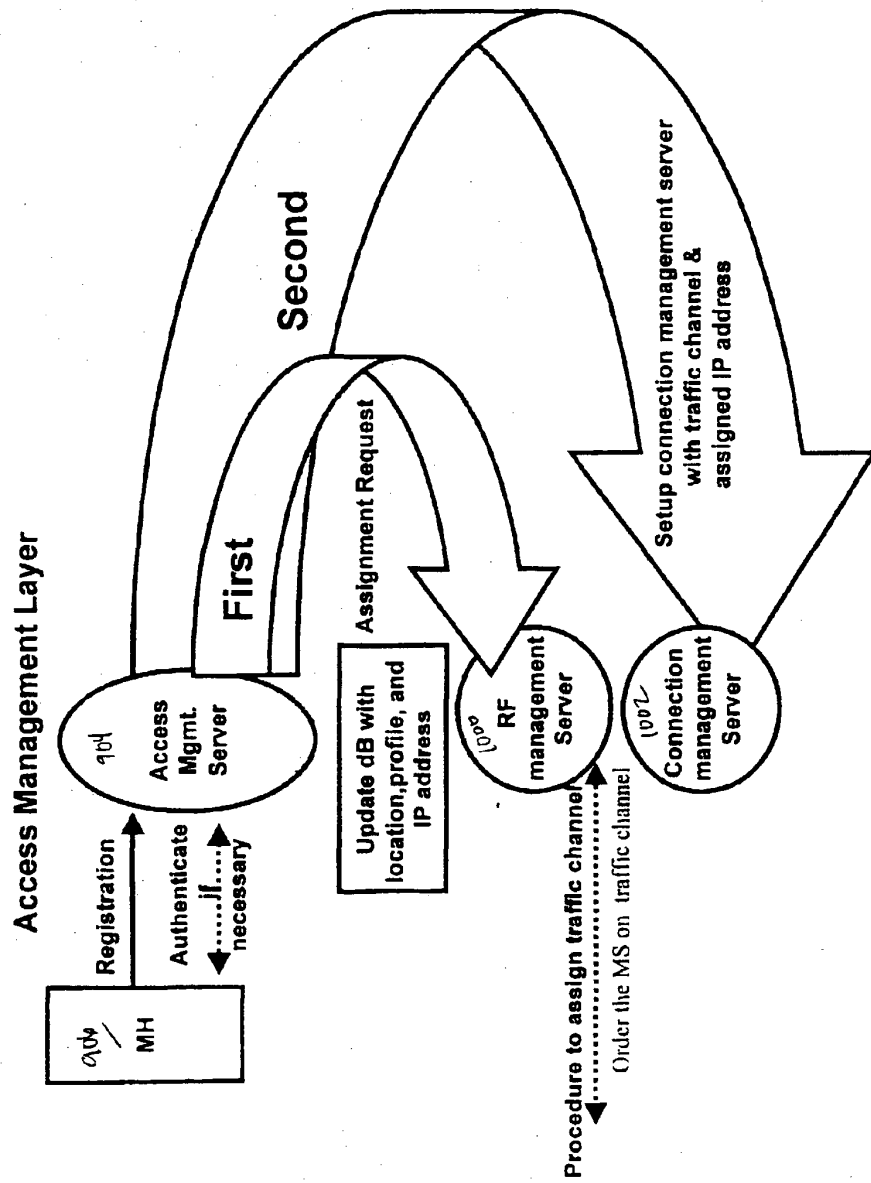


FIGURE 10

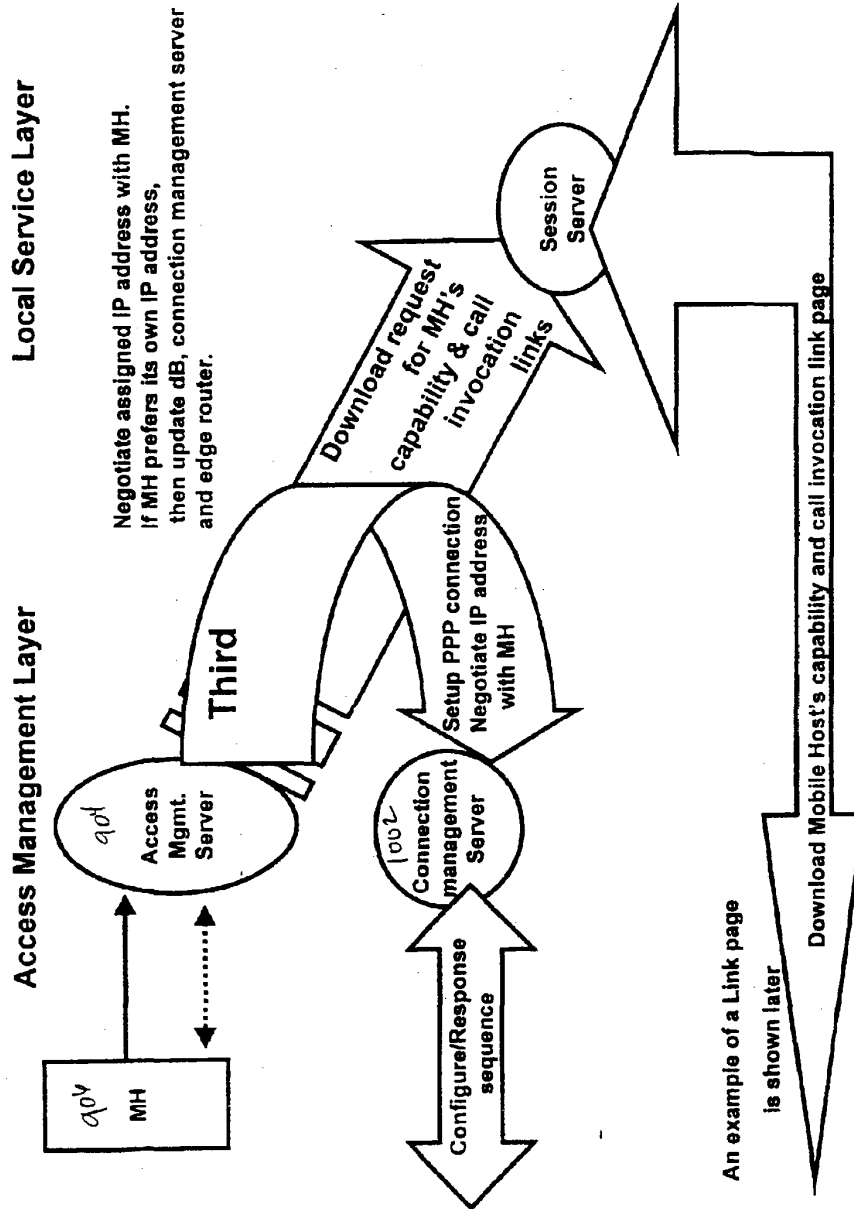


FIGURE 11

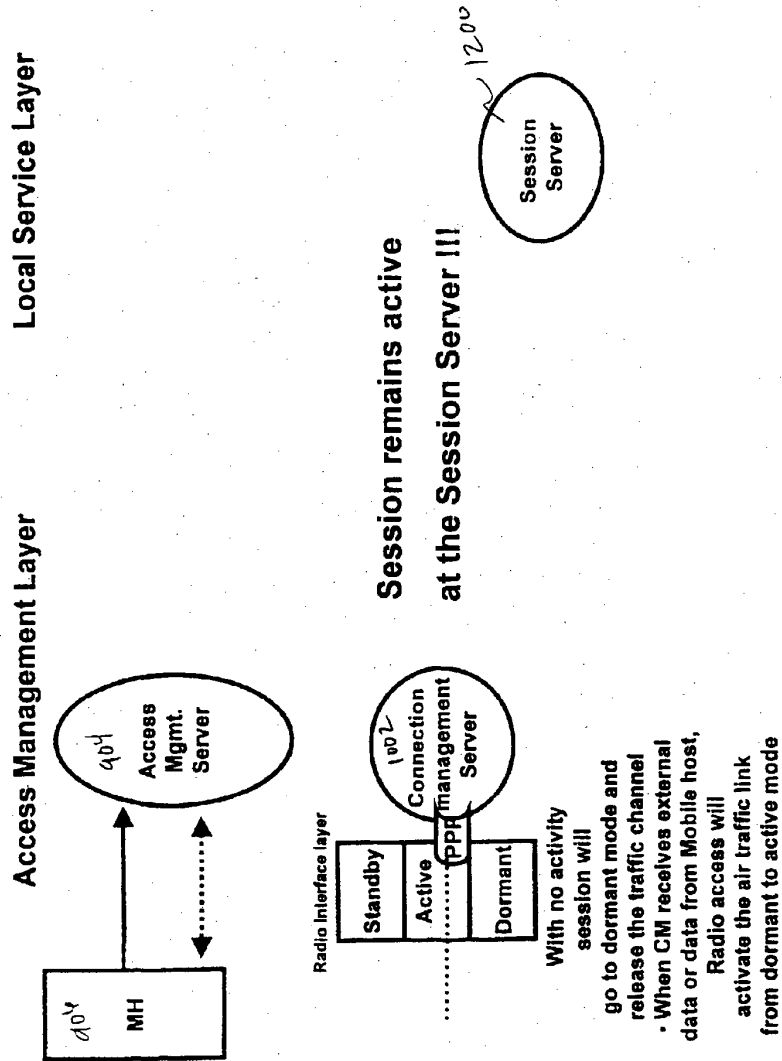


FIGURE 12

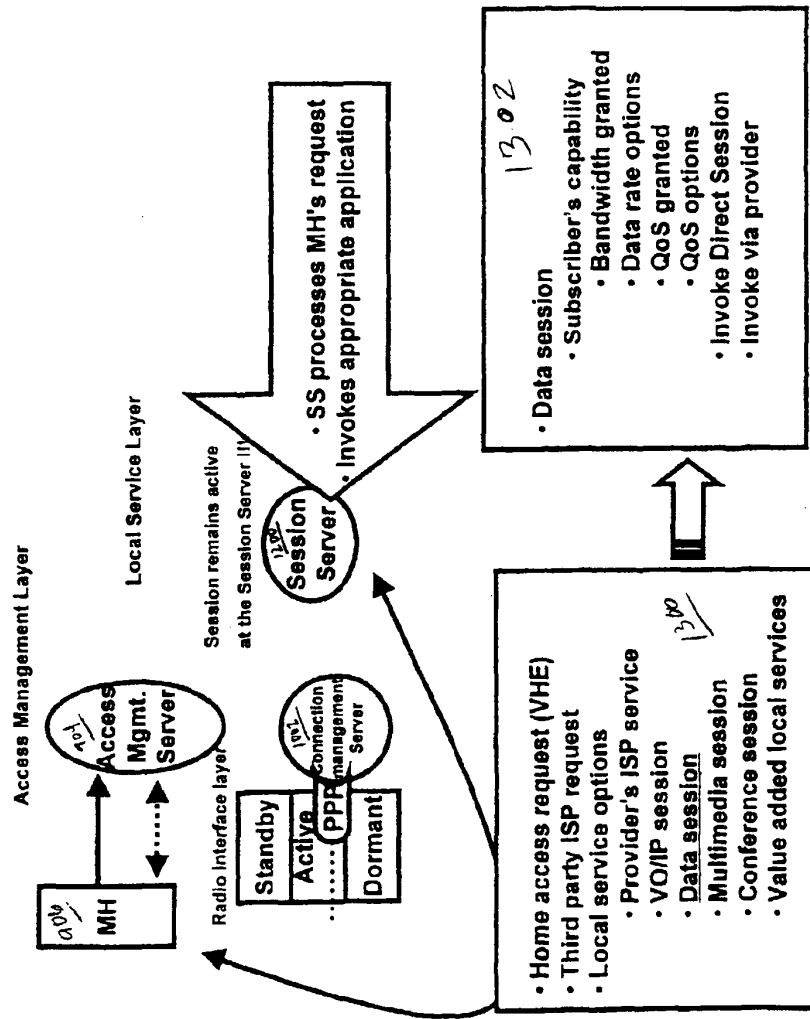
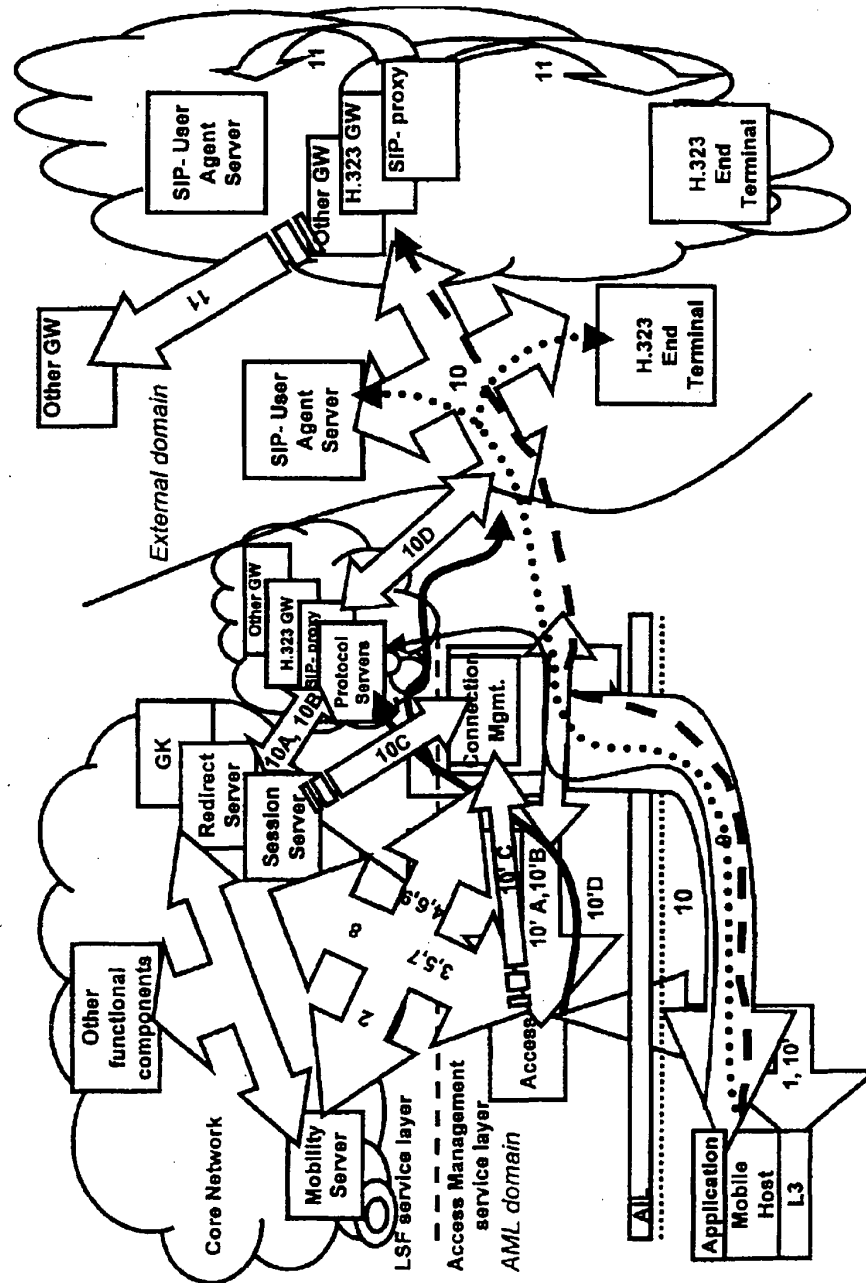


Figure 13

FIGURE 14



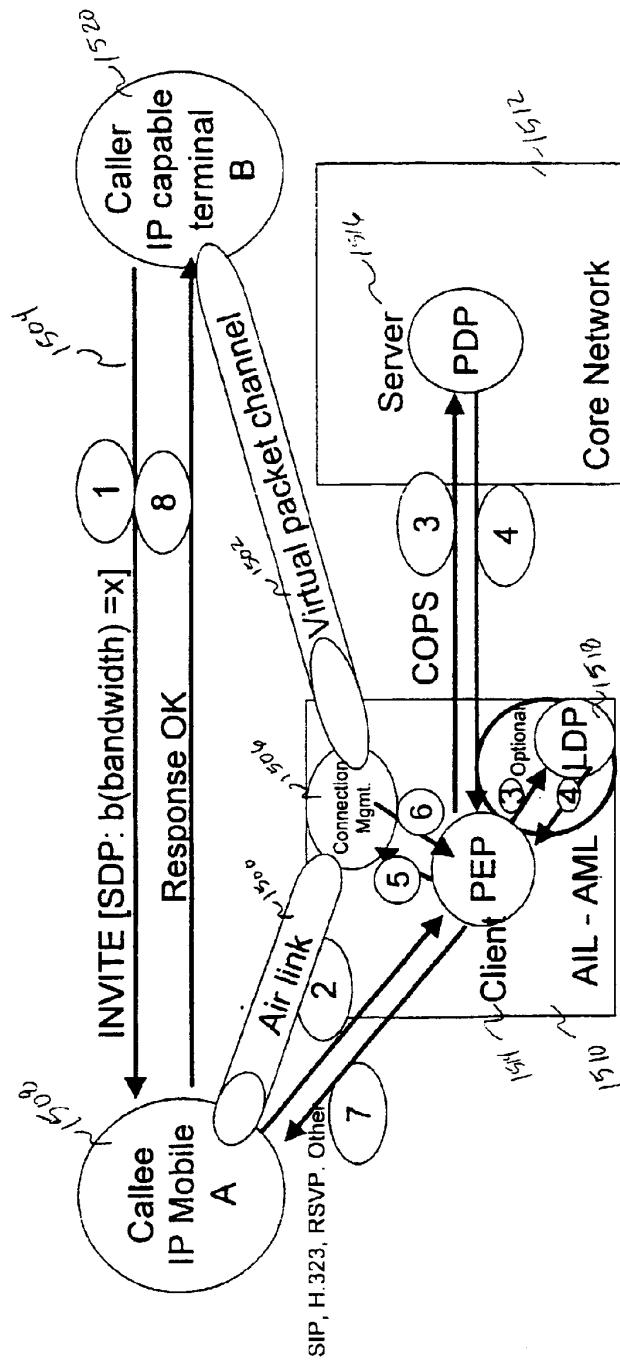


Figure 15

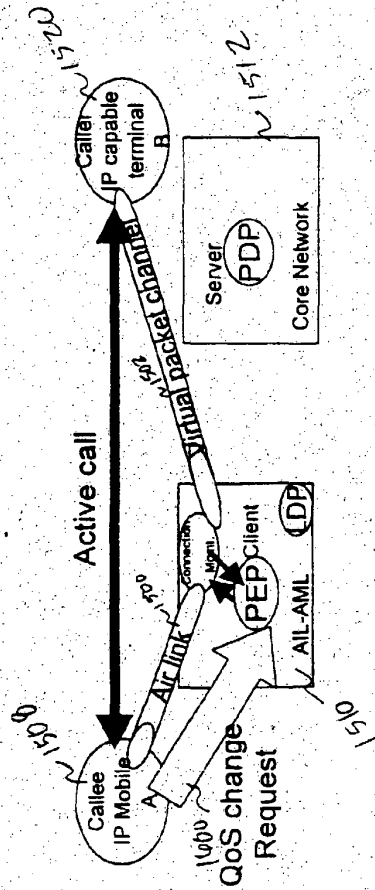


Figure 16

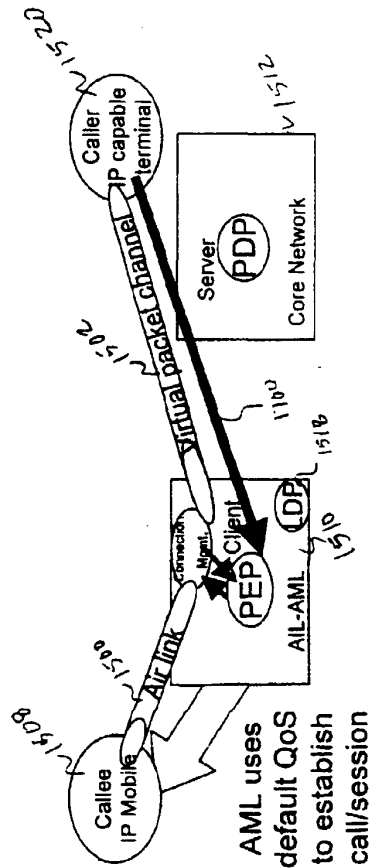


FIGURE 17

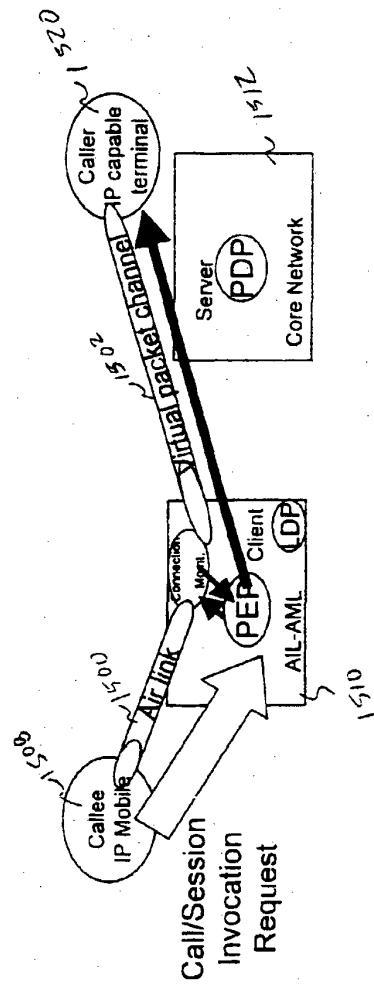


Figure 18

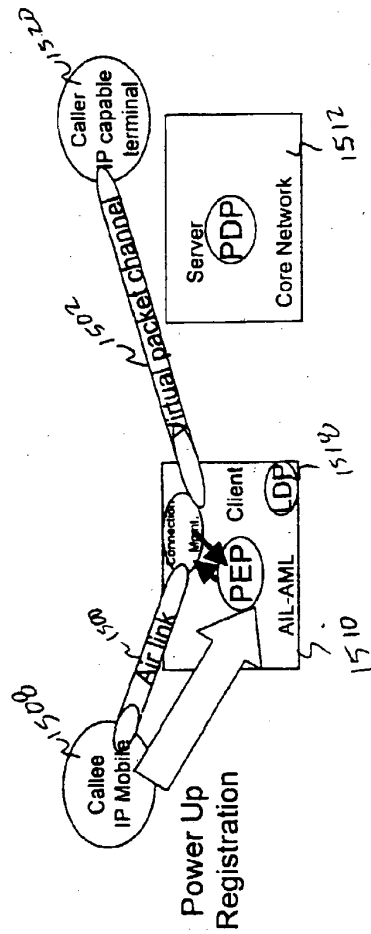
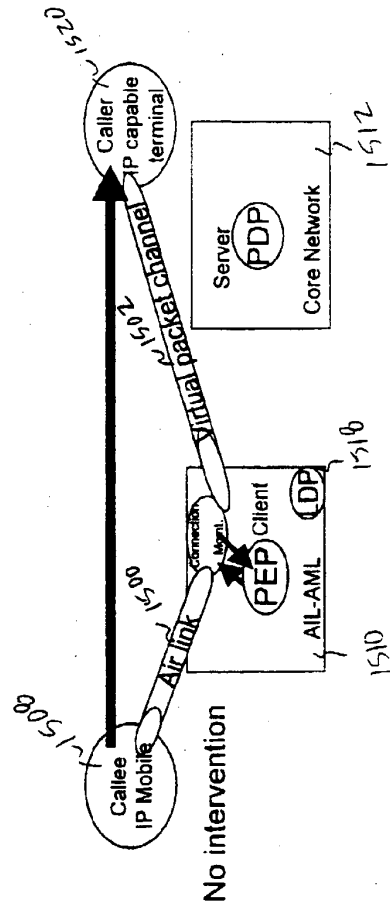
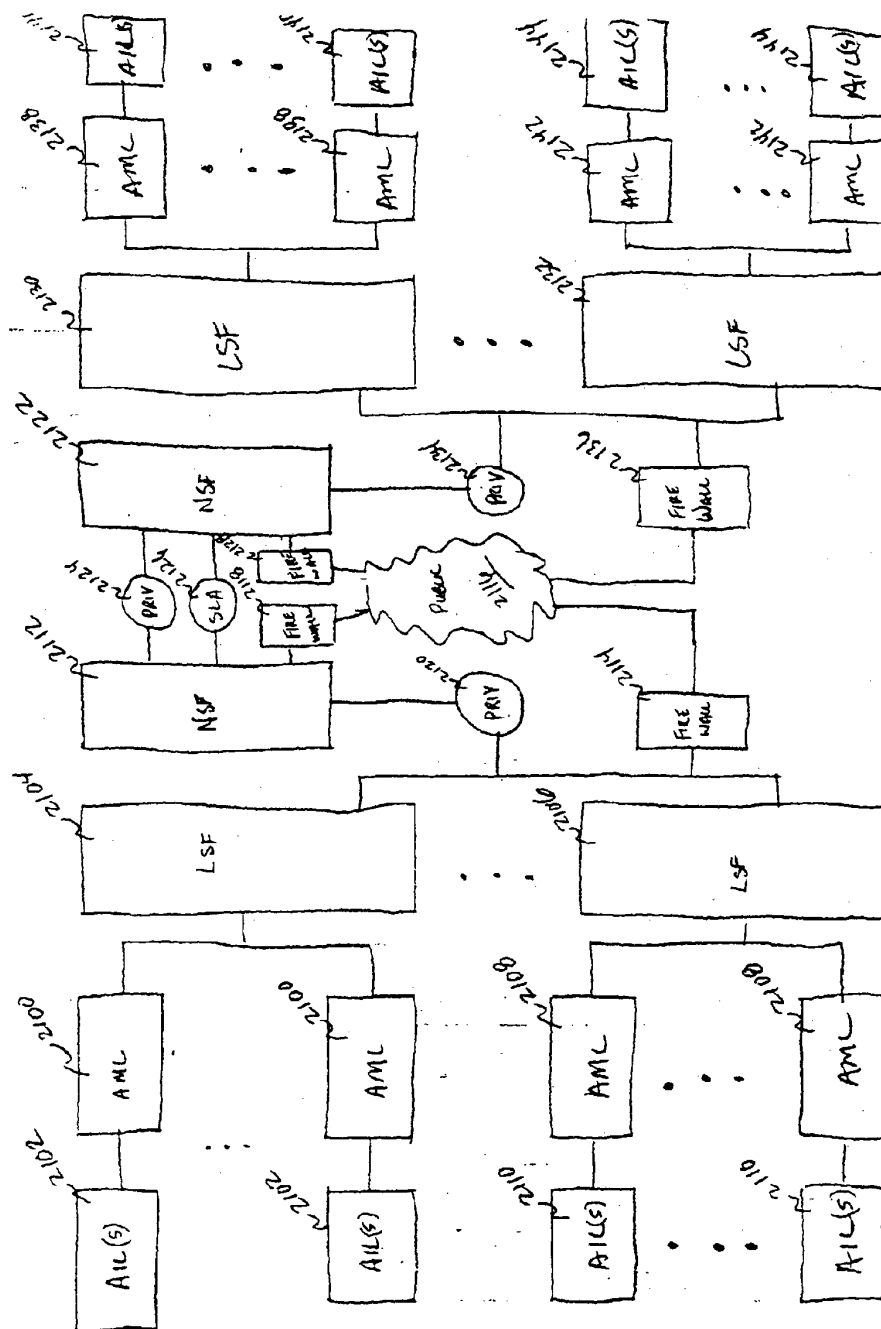


FIGURE 19

FIGURE 20





(19)



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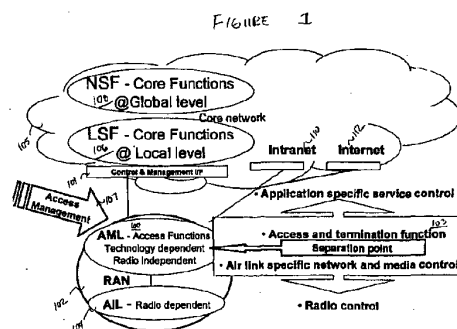
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(54) An architecture for an IP centric distributed network

(57) A method and system to for a communications network architecture for an Internet Protocol centric wireless network for a first user to communicate to a destination, the architecture comprising: a network service function layer within the wireless network. The network service function layer can include: a policy management server; an authorization server; a service accounting server; an authentication, authorization and accounting server; an unified directory within a directory server; a security gateway; and a mobility manager. The architecture also includes a local service function layer associated with the network service function layer. The local service function layer can include: an access accounting server; an authentication, authorization and accounting server; a security gateway; a policy enforcement server; a mobility manager; a network management server; and a wireless gateway. The architecture also includes an access management layer associated with the local service function layer. The access management layer can include: a location tracking server; a connection management server; a protocol server; an access management server; a policy enforcement server; a network management server; and a resource management server. The architecture also includes an access interface layer associated with the access management layer. The access interface layer can include: a channel management server; a policy enforcement

server; an administration and maintenance server; and a radio frequency server.

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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Y	* page 1, line 17 - line 24 * * page 9, line 2 - line 5 * * page 9, line 27 - page 10, line 23 * * page 11, line 7 - line 30 * * page 12, line 26 - line 29 * * page 14, line 27 - line 29 * * page 19, line 28 - line 35 * * page 22, line 15 - line 20 * * figure 1 *	6,15,24, 25,35, 43,51, 64,72,73	
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The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 1 July 2003	Examiner HORN, R
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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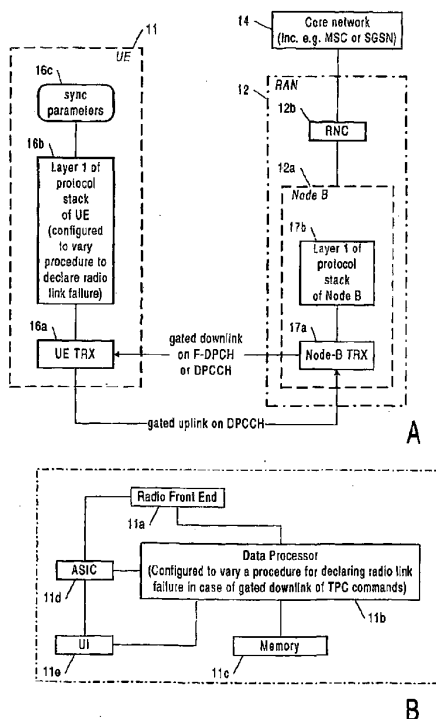
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[Continued on next page]

(54) Title: ENHANCED UE OUT-OF-SYNC BEHAVIOR WITH GATED UPLINK DPCCH OR GATED DOWNLINK F-DPCH OR DPCCH TRANSMISSION



(57) Abstract: A method and corresponding equipment by which a wireless terminal communicatively coupled to a radio access network adapts to gating in respect to a downlink signal from a radio access network carrying power control commands (e.g. the F-DPCH of UTRAN with WCDMA), including gating by the radio access network of either just the power control commands or the channel itself, or gating of reception of the power control commands by the user equipment. The adaptation can include changing values of parameters used in determining when the wireless terminal declares a radio link failure, or instead only changing the procedures used to determine whether a parameter value has been achieved and thus only effectively changing the parameter values (or one or more of the parameters can be actually and effectively changed).



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

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ENHANCED UE OUT-OF-SYNC BEHAVIOR WITH GATED UPLINK
DPCCH OR GATED DOWNLINK F-DPCH OR DPCCH TRANSMISSION

CROSS REFERENCE TO RELATED APPLICATION

Reference is made to and priority claimed from U.S.
provisional application Ser. No. 60/797,943 filed 5 May 2006.

BACKGROUND OF THE INVENTION

1. *Technical Field*

The present invention pertains to the field of wireless communications. More particularly, the present invention pertains to procedures to be followed by wireless terminals in case of gating of transmit power by the wireless terminals.

2. *Discussion of related art*

In some wireless communications systems, in particular UMTS (Universal Mobile Telecommunications System) using WCDMA (Wideband Code Division Multiple Access) for the air interface of its UTRAN (UMTS terrestrial radio access network), in order to save power a UE (user equipment) wireless communication terminal could turn its transmit power on and off, i.e. it could gate its transmit power according to a gating pattern (among other factors), i.e. according (at least in part) to a duty cycle having an on period and an off period. Using a UTRAN with WCDMA as an example, a UE sends data and/or control information (such as pilot bits) to a Node-B of the UTRAN, and the Node-B then estimates the UE uplink quality based on the control information, and commands the UE to change its transmit power accordingly. If a UE were to use transmit power gating, there would then be periods of time in which no control information would be transmitted, and correspondingly, there could be periods of time in which no power change commands would be issued by the Node-B, or periods of time in

which if the Node-B were to issue power change commands, the commands would be based on unreliable quality information (signal to interference ratio measurements, for example) because of no control bits having been transmitted for the period of time in which the quality measurements are made (taking into account the time it takes for a transmission from the UE to reach the Node-B).

At present, there are procedures according to which a UE is to declare a radio link failure based on a predetermined threshold for minimum quality of the signal from the Node-B, and a predetermined value for a number of consecutive below threshold quality indications. These procedures and the predetermined threshold and number of below minimum quality indications assume continuous transmit power by the UE. But if a UE were to gate its uplink, then because the Node-B would in effect follow and gate its downlink (because of having no control information to estimate the uplink quality from when the UE is not transmitting), and because the UE uses the downlink as a basis for estimating the quality of the radio link, the UE could declare a radio link failure when in fact there would be no such failure. The apparent inability to "hear" the Node-B for a period of time would be due simply to the Node-B not transmitting during that period of time, not because of poor radio link quality.

What is needed, therefore, is a way to adapt the procedure for declaring a radio link failure, and also related procedures, in case of a UE gating its uplink.

UTRAN with WCDMA as the radio technology is a particular example of the need for a new procedure for declaring a radio link failure. First consider the need for gating by a UE. When no dedicated channels (DCHs)--and thus, no dedicated physical data channels (DPDCHs) (which carry payload as well as high-level signalling)--have been configured in the uplink

(UL), all data is transmitted on the enhanced data channel (E-DCH), which is mapped to the enhanced dedicated physical data channel (E-DPDCH). Control signalling associated with E-DCH is transmitted on E-DPCCH. E-DPDCH and E-DPCCH are discontinuous, i.e. they are transmitted only when there is data to be transmitted and the transmission has been granted by the network. For an E-DCH transmission, a grant is needed: a non-scheduled grant for non-scheduled MAC-d (media access control-d) flows and a serving grant (and an allowed, active HARQ process) for scheduled transmissions.

The UL DPCCH carries control information generated at Layer-1 (i.e. the physical layer of the protocol stack). The layer-1 control information consists of e.g. known pilot bits for supporting channel estimation for coherent detection, for use in the Node-B determining transmit power control (TPC) commands to downlink (DL) on DPCH or on Fractional-DPCH (F-DPCH), feedback information (FBI), and an optional transport format combination indicator (TFCI).

UL DPCCH is continuously transmitted (even if there is no data to transmit for awhile), and there is one UL DPCCH for each radio link. Continuous transmission is acceptable with circuit-switched services, which typically send continuously. For bursty packet services, however, continuous DPCCH transmission is less desirable because it has substantial overhead.

The uplink capacity can be increased by decreasing the control overhead. One possibility for decreasing control overhead is UL DPCCH gating, i.e., not transmitting DPCCH all the time. A pattern could (at least in part) define the DPCCH transmission time periods and/or DPCCH may depend (also) on E-DCH and HS-DPCCH transmission times. (Other rules may in effect supercede the pattern so that from time to time the UE may uplink during what would ordinarily be an off-period/gap

in the transmission, with the net result being irregular transmission, i.e. not strictly according to a pattern.) Gating can provide UE power saving and so longer battery life, depending on the duty cycle, i.e. the length of on period for DPCCH compared to the off period. Also, interference with other UEs could be reduced, and thus network capacity could be increased.

F-DPCH carries TPC command bits to a UE determined by the Node-B serving the UE, based on data and/or control information uplinked by the UE on DPCCH. F-DPCH is currently transmitted every time slot, independently of the data or control transmission activity by the UE, i.e. independent of whether the UE gates the DPCCH. However, in case of UL DPCCH gating by the UE so that an UL DPCCH time slot does not contain data and/or control transmission by the UE (i.e. because the UE does not transmit during that UL DPCCH time slot on account of its gating), the Node-B cannot derive a sensible power control command corresponding to the time slot, to transmit on F-DPCH. Thus, if UL DPCCH is to be gated, F-DPCH and/or DL DPCCH could also be gated and/or discontinuously received. Discontinuous DL transmission decreases downlink interference and corresponding discontinuous reception by the UE improves UE battery consumption.

With respect to power control commands issued by the serving Node-B, a UE is considered out-of-sync (not synchronized) if the DL DPCCH quality or the quality of the TPC fields of the F-DPCH frame received from the serving HS-DSCH cell over the previous 160 ms period is worse than a threshold Q_{out} defined (implicitly) by tests in 3GPP TS 25.101. A UE is considered in-sync (synchronized) if the UE estimates the quality of the DL DPCCH or the TPC fields of the F-DPCH frame received from the serving HS-DSCH cell over the previous

160 ms period to be better than a threshold Q_{in} also defined (implicitly) by tests in 3GPP TS 25.101.

According to 3GPP TS 25.101, if a UE estimates the DPCH quality or the quality of the TPC fields of the F-DPCH frame received from the serving HS-DSCH cell over the last 160 ms period to be worse than the threshold Q_{out} , the UE is to turn its power off. On the other hand, if a UE estimates the DPCH quality or the quality of the TPC fields of the F-DPCH frame received from the serving HS-DSCH cell over the last 160 ms period to be better than the threshold Q_{in} , the UE is to turn its power on. A UE is to determine that radio link failure has occurred if after some number N_{313} of consecutive out-of-syncs have been indicated (N_{313} being the label of a parameter whose value is the number), less than some number N_{315} of successive in-syncs are indicated before some number T_{313} of time periods expires (where the counting toward the number T_{313} is starting from when the N_{313} consecutive out-of-syncs are indicated).

DISCLOSURE OF INVENTION

The invention provides a method for use by a user equipment wireless communication terminal, comprising: determining on periods and off periods of a gated transmission in connection with receiving power control commands over a downlink channel of a radio access network; and varying a procedure used to determine when to declare a radio link failure based on the gated transmission by actually and/or effectively varying a quality measurement period used in the procedure or a parameter value used in the procedure. To actually vary a parameter, the value of the parameter would be changed. To only effectively vary a parameter, a procedure using the parameter is changed but the value of the parameter is not changed (so that the same parameter value then has a different effect).

Corresponding equipment, including computer program products and application specific integrated circuits are also provided. In addition, wireless terminals are provided including such equipment and so operative according to methods provided by the invention. Also, a wireless communication system including elements communicatively coupled to such wireless terminals are also provided.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the invention will become apparent from a consideration of the subsequent detailed description presented in connection with accompanying drawings, in which:

Figure 1A is a block diagram/ flow diagram of a UE and a Node-B communicatively coupled via a radio link including a gated uplink channel and a gated downlink channel, and showing parameters stored in the UE for use in (among other things) determining when to declare a radio link failure.

Figure 1B is a reduced block diagram (only portions relevant to the invention being shown) of the UE terminal or the Node B of Figure 1A.

Figure 2 is a block diagram showing a layer one (physical layer) of a protocol stack implemented in the UE receiving as inputs information indicating the gated downlink, and also the sync parameter values in case of no downlink gating, and providing changed sync parameters.

Figure 3 is a flow chart of the operation of a UE, according to the invention.

Figure 4 is a flow chart of the operation of a Node, B according to the invention.

The invention provides a method by which a UE, communicatively coupled to a Node-B of a UTRAN (UMTS radio access network) (or coupled to a corresponding entity of a radio access network on another cellular technology), adapts to gating (so as to perform what is sometimes called discontinuous transmission) of a downlink channel (F-DPCH or DPCH) carrying power control commands from the Node-B. As explained above, such gating of the downlink can be the direct result of gating of the uplink by the UE, or can be at least associated with such gating, and the downlink gating is presumed known or knowable to the UE (as a result of monitoring/ measurements or other mechanism not the subject of the invention). As also explained above, the UE is required by standards to turn its power off in case of a number of consecutive out-of-sync indications, each corresponding to a determination that a quality metric for receiving control commands from the Node-B is below a threshold Q_{out} . Without adapting to such gating, the UE could turn its power off more than is desirable because of out-of-sync indications due simply to the Node-B not transmitting for a period of time--the off period of an on/off duty cycle. As indicated above, what is needed therefore, is a way to adapt the procedure for declaring a radio link failure, and also related procedures, in case of a UE gating its uplink.

In case of gating, different options exist for how the out-of-sync criterion could be determined. In general, according to the invention, to accommodate gating by the Node-B, the UE actually and/or effectively varies one or more parameter values used to determine when to declare a radio link failure based on the downlink gating. To actually vary a parameter, the value of the parameter is changed. To effectively vary a parameter, a procedure using the parameter

is changed but the value of the parameter used in the procedure is not. For example, a procedure could require a number N of occurrences of an event in a time T . To actually vary N , the value of N would be changed, but not (necessarily) the value of T . (Alternatively, the value of T could be actually changed.) To effectively vary N , how T is measured could be changed. (This can also be viewed as effectively changing the value of T .) For example, the procedure could be changed so that off-period of a duty cycle does not count in measuring T .

Now in a first option for how the out-of-synch criterion could be determined, the Q_{out} and Q_{in} thresholds and the measurement window (the 160 ms time period) could be kept unchanged, and values for the parameters $N313$, $T313$ and $N315$, could be signaled to a UE to achieve the desired behavior for the downlink gated transmission. However, this has as a disadvantage lowered reliability of Q_{in} or Q_{out} due to a lower number of samples. In addition, the parameters are currently broadcast, and so they would need to be separately set for each user having a different gated transmission.

In a second option, the thresholds and parameters could be kept unchanged, but the measurement window could be increased (from 160 ms), or instead only effectively increased by counting only time increments when according to the gated transmission by the Node-B there is an actual downlink transmission. With both approaches--increasing the window or only changing how time is counted as contributing to the window--the measurement window could be set so that the number of evaluated samples (in terms of TPC commands) would be kept constant. This way the reliability of Q_{in} or Q_{out} could be improved.

In a third option, the option provided by the invention in at least some embodiments, the $N313$, $T313$ and $N315$

parameter values would be broadcast by the network as before (and so known to all UEs served by the Node-B broadcasting the parameters). However, a UE would autonomously adjust one or more of the broadcast values for the N313, T313 and/or N315 parameters based on an on period and an off period of a gated transmission having an on/off duty cycle and associated with the transmission of the power control commands on the downlink channel of the radio access network, based on a predetermined methodology. In some other embodiments, the UE could adjust the values it used for the thresholds Q_{out} and Q_{in} .

In case of a UE changing the values it uses for one or more of the N313, T313 and N315 parameters, the methodology could, for example, increase the value of the T313 value and so lengthen the time before a radio link failure is declared (and perhaps prevent declaring a radio link failure because of allowing more time to receive an in-sync indication after N313 out-of-sync indications). For example, the T313 parameter would be increased by the percentage of time the Node-B is not transmitting compared to the total time. Alternatively, the methodology could increase the number N313 to require a greater number of out-of-sync indications, and again for example, in direct proportion to the off period of the duty cycle compared to the whole period of the duty cycle. (This alternative starts the T313 and N315 usage and thus has the greatest impact.) In still another alternative, the methodology could decrease the number N315 and so decrease the number of consecutive in-sync indications (before T313 units of time has expired) required to prevent a declaration of radio link failure (after N313 consecutive out-of-sync indications have been observed).

The invention also encompasses changing not just one of the N313, T313 and N315 parameters, but any combination of these parameters. Also, instead of changing a parameter value in direct proportion to the length of the off-period of the

gated transmission (i.e. the off-period of the duty cycle of the UE transmitter), the parameter values could be changed in some other proportion, i.e. in a non-linear way.

As an alternative to changing the values of the N313, T313 and N315 parameters, the UE could change how it counts consecutive out-of-sync indications, and how it counts consecutive in-sync indications, and/or how it measures the time period corresponding to T313. The UE could, for example, only count as a consecutive out-of-sync indication an indication of out-of-sync occurring in a time when the Node-B gated transmission is in an on-period, i.e. when the Node-B is known by the UE to be transmitting. Similarly for the counting up to N315 in-sync indications, and similarly for measuring time after N313 consecutive out-of-sync indications (i.e. time would be measured only when the Node-B is known to be transmitting). Thus, the UE could only effectively change one or more of the N313, T313 and N315 parameter values, by changing how the UE determines whether a condition(s) corresponding to the one or more parameter values has occurred, e.g. changing the procedure used to monitor out-of-sync indications so as to count as a consecutive out-of-sync indication such an indication only if the out-of-sync indication occurs during the on period of the on/off duty cycle (and only if there has not been an in-sync indication anytime between the most recent previous out-of-sync indication occurring during an on period).

In order to vary (one or more of) the N313, T313 and N315 parameters (actually or just effectively), the UE must learn/determine the on period and the off period of the on/off duty cycle used by the Node-B of the radio access network in gating the downlink channel conveying the power control commands. One way for the UE to determine the on and off periods of the duty cycle is by assuming that they are the same as the on and off periods of the duty cycle used by the UE in gating its

uplink (on DPCCH), and so equating the downlink gated transmission by the Node-B to the uplink gated transmission of the UE. Another way is to monitor the downlink, observing the pattern of variation in received power on the gated downlink channel (for example, the F-DPCH in case of WCDMA and UTRAN), and equating the off period of the gated downlink pattern to the observed period of low received power, and equating the on period to the observed period of higher low received power. Another way is for the UE to receive via signaling from the Node-B information indicating the gated transmission used by the Node-B, and to determine from the signaling the on period and the off period of a duty cycle.

As mentioned, a UE could also change one or more of the values it uses for the thresholds Q_{out} and/or Q_{in} . This could be as an alternative to changing one or more of the N313, T313 and N315 parameters, or in addition. A UE could autonomously adjust the values it uses for the thresholds Q_{out} and/or Q_{in} , or it could select the values of the thresholds from a predefined set (in determining when out-of-sync or in-sync occurs and through out-of-sync / in-sync indications determining when a radio link failure is deemed to have occurred).

Instead of gating the downlink channel (and in particular, F-DPCH or DPCCH), the downlink channel could be continuously transmitted but discontinuously power controlled due to uplink gating, i.e. power control commands could be sent only in downlink time slots corresponding to uplink time slots when the UE is transmitting. Alternatively, the downlink channel (F-DPCH or DPCCH) could be continuously transmitted, but discontinuously received by the UE, in order to improve UE power consumption. Discontinuous power control potentially degrades performance during uplink transmission gaps and right after the gaps. Therefore methods could be applied similar to those described above and below (for use in case of a gated downlink channel) that treat downlink

transmission during periods corresponding to an uplink transmission gap similarly to downlink off periods (of a gated downlink). Discontinuous reception is in effect the same as a gated downlink channel from the standpoint of F-DPCH usage in the UE and performance.

Referring now to Figure 1A, a UE 11 is shown communicatively coupled to a Node-B 12a of a UTRAN 12, via a radio link having an uplink and a downlink, where the downlink is gated according to a gated transmission, and the uplink is also gated (and as explained above, may cause the gating of the downlink). As illustrated, the UTRAN also includes a Radio Network Controller (RNC) 12b, for controlling the Node-B in at least some respects, and for coupling the Node-B to a Core Network 14 (and hence ultimately to other communication terminals, not shown). The UE is shown as including a UE transceiver (TRX) 16a rigged for radio communication with a corresponding Node-B TRX 17a. The UE is shown as also including a Protocol Stack Layer-1 16b that operates the UE TRX 16a, and the Node-B is shown as including a peer Protocol Stack Layer-1 17b. The UE is shown as also including a data store 16c for holding values of the various parameters and/ or thresholds used in different embodiments of the invention, called here the sync parameters.

Figure 1B shows some components of the UE 11 of Figure 1A from a different perspective. The UE is shown as including a suitable radio front end 11a (including a wireless transceiver, not shown) coupled to a data processor 11b that in turn is coupled to a (volatile and/or non-volatile) memory structure 11c. The data processor can be for example a microprocessor, i.e. a programmable digital electronic component that incorporates the functions of a central processing unit on a single semiconducting integrated circuit. The radio front end may include a digital signal processor (not shown), or the data processor 11b may provide digital

signal processing in respect to signals transmitted or received by the wireless terminal. The memory structure 11c stores program code that is executable by the processor 11b, including program code that is provided to implement all or part of the invention. The UE 11, as shown, can also include one or more application specific integrated circuits 11d, for providing some or all of the functionality of the UE, as an alternative to providing the functionality via stored instructions executed by the processor. Finally, the UE 11, as shown, includes a user interface (UI) 11e (usually including, among other things, a display, a keypad, a microphone, and a speaker), coupled to the data processor and possibly also to one or more of the one or more ASICs. The UE TRX 16a of Figure 1A is a component of the radio front end 11a. The UE Protocol Stack Layer-1 16b of Figure 1A can be implemented so as to include one or more ASICs 11d, and/or program code stored in the memory structure 11c executable by the data processor 11b, and/or one or more components of the radio front end 11a.

Although not illustrated in the drawings, it will be appreciated that each Node-B 12a also includes a radio front end and a data processor and a memory structure and may include one or more ASICs coupled as shown in Figure 1B, and the RNC 12b also includes a data processor and a memory structure and possibly one or more ASICs.

In general, the various embodiments of the UE 11 can include, but are not limited to, cellular telephones, personal digital assistants (PDAs) having wireless communication capabilities, portable computers having wireless communication capabilities, image capture devices such as digital cameras having wireless communication capabilities, gaming devices having wireless communication capabilities, music storage and playback appliances having wireless communication capabilities, Internet appliances permitting wireless Internet

access and browsing, as well as portable units or terminals that incorporate combinations of such functions.

Referring now also to Figures 2 and 3, in a first step 31, the UE determines that the downlink is gated, and then in a next step 32 adjusts values of one or more of the sync parameters it uses (actually or only effectively, as described above) compared to values used in case of no gating of the downlink. The term "sync parameter" is used here to indicate any one or more of the N and T parameters (N313, T313 and N315), and/ or any one or more of the thresholds (Q_{out} and Q_{in}). The adjustment is based on the downlink gated transmission. (As explained above, the adjustment may be based on, or may be proportional to, the off period of the on/off duty cycle of the gated transmission.) In Figure 2, the UE is shown (optionally) obtaining original values of the procedures and then storing the changed sync parameters (i.e. their values) in a data store of the UE for use for example in determining when to declare a radio link failure (or otherwise responding to out-of-sync or in-sync indications). As indicated in Figures 1 and 2, the functionality for changing the sync parameters can reside in the layer one (physical layer) implementation (in hardware or software) of the UE protocol stack.

Referring now to Figure 4, the Node-B is indicated there as operative according to a first step 41 in which the Node-B determines that the UE is gating its uplink. The Node-B can make such a determination by for example monitoring the power received on the uplink channel in case of a dedicated channel. In a next step 42, the Node-B gates its downlink to correspond to the uplink gating by the UE. For example, as explained above, the Node-B can simply respond to power change requests actually received (during an on period of the UE uplink gated transmission), and even turn off its receiver during the off period of the UE uplink.

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The functionality described above as provided by the invention can be implemented as software modules stored in a non-volatile memory of a device such as a mobile station, and executed as needed by the device (or more specifically, an operating system of the device) copying all or part of the software into executable RAM (random access memory). Alternatively, the logic provided by such software can also be provided by an ASIC (application specific integrated circuit). In case of a software implementation, the invention provided as a computer program product including a computer readable storage structure embodying computer program code--i.e. the software--thereon for execution by a computer processor.

It is to be understood that the above-described arrangements are only illustrative of the application of the principles of the present invention. Numerous modifications and alternative arrangements may be devised by those skilled in the art without departing from the scope of the present invention, and the appended claims are intended to cover such modifications and arrangements.

What is claimed is:

1. A method for use by a user equipment wireless communication terminal, comprising:

determining on periods and off periods of a gated transmission in connection with receiving power control commands over a downlink channel of a radio access network;
and

varying a procedure used to determine when to declare a radio link failure based on the gated transmission by actually and/or effectively varying a quality measurement period used in the procedure or one or more parameter values used in the procedure.

2. A method as in claim 1, wherein the gated transmission corresponds to a gating of transmission power or a gating of only the power control commands or a gating of reception of the power control commands by the UE.

3. A method as in claim 1, wherein the procedure is varied by changing how to measure a parameter value used by the procedure.

4. A method as in claim 3, wherein the change in the procedure is to count occurrences of events corresponding to the parameter value only if the events occur during one or another of the on periods of the gated transmission, instead of counting occurrences of such events regardless of when the events occur.

5. A method as in claim 3, wherein the change in the procedure is to count occurrences of events corresponding to the parameter for a period of time longer than in case of no gating.

6. A method as in claim 5, wherein the procedure used to measure when the parameter value is changed includes evaluating

power change commands received during a time window, and wherein the change in the procedure is to evaluate power change commands over a longer time window.

7. A method as in claim 6, wherein the longer time window is longer than the time window in case of no gating by an amount such that the same number of power change commands are evaluated as in case of no gating.

8. A method as in claim 1, wherein the procedure uses one or more parameter values including a number N313 of consecutive out-of-sync indications, and/or a number N315 of successive in-sync indications, and/or a number T313 indicating a length of time, and/or a first threshold Q_{out} for minimum quality and/or a second threshold Q_{in} for minimum quality, and wherein the radio link to the radio access network is declared failed according to the procedure if N313 consecutive out-of-sync indications are determined and then a time interval of T313 units of time expires before N315 consecutive in-sync indications are determined, wherein an out-of-sync indication is determined whenever a quality metric for the downlink channel falls below the first threshold Q_{out} for minimum quality, and an in-sync indication is determined whenever the quality metric exceeds the second threshold Q_{in} for minimum quality.

9. A method as in claim 1, wherein the on periods and the off periods each correspond respectively to an on period and an off period of a duty cycle, and wherein at least one of the parameter values is changed from a broadcast or predetermined value by an amount that is based on the off period compared to a whole period of the on/off duty cycle.

10. A computer program product comprising a computer readable storage structure embodying computer program code thereon for execution by a computer processor, wherein said computer program

code comprises instructions for performing a method according to any of claims 1-9.

11. An application specific integrated circuit provided so as to operate according to a method as in any of claims 1-9.

12. An apparatus for use by a user equipment wireless communication terminal, comprising:

means for determining on periods and off periods of a gated transmission in connection with receiving power control commands over a downlink channel of a radio access network; and

means for varying a procedure used to determine when to declare a radio link failure based on the gated transmission by actually and/or effectively varying a quality measurement period used in the procedure or a parameter value used in the procedure.

13. An apparatus as in claim 12, wherein the gated transmission corresponds to a gating of transmission power or a gating of only the power control commands or a gating of reception of the power control commands by the UE.

14. An apparatus as in claim 12, wherein the means for varying a procedure is configured to vary the procedure by changing how to measure a parameter value used by the procedure.

15. An apparatus for use by a user equipment wireless communication terminal, comprising:

a first component of a physical layer implementation of a protocol stack of a wireless terminal, for determining on periods and off periods of a gated transmission in connection with receiving power control commands over a downlink channel of a radio access network; and

a second component of a physical layer implementation, for varying a procedure used to determine when to declare a radio link failure based on the gated transmission by actually and/or effectively varying a quality measurement period used in the procedure or a parameter value used in the procedure.

16. An apparatus as in claim 15, wherein the gated transmission corresponds to a gating of transmission power or a gating of only the power control commands or a gating of reception of the power control commands by the UE.

17. An apparatus as in claim 15, wherein the second component is configured to vary the procedure by changing how to measure a parameter value used by the procedure.

18. An apparatus as in claim 17, wherein the change in the procedure is to count occurrences of events corresponding to the parameter value only if the events occur during one or another of the on periods of the gated transmission, instead of counting occurrences of such events regardless of when the events occur.

19. An apparatus as in claim 17, wherein the change in the procedure is to count occurrences of events corresponding to the parameter for a period of time longer than in case of no gating.

20. An apparatus as in claim 19, wherein the procedure used to measure when the parameter value is changed includes evaluating power change commands received during a time window, and wherein the change in the procedure is to evaluate power change commands over a longer time window.

21. An apparatus as in claim 20, wherein the longer time window is longer than the time window in case of no gating by an amount such that the same number of power change commands are evaluated as in case of no gating.

22. An apparatus as in claim 15, wherein the procedure uses one or more parameter values including a number N313 of consecutive out-of-sync indications, and/or a number N315 of successive in-sync indications, and/or a number T313 indicating a length of time, and/or a first threshold Q_{out} for minimum quality and/or a second threshold Q_{in} for minimum quality, and wherein the radio link to the radio access network is declared failed according to the procedure if N313 consecutive out-of-sync indications are determined and then a time interval of T313 units of time expires before N315 consecutive in-sync indications are determined, wherein an out-of-sync indication is determined whenever a quality metric for the downlink channel falls below the first threshold Q_{out} for minimum quality, and an in-sync indication is determined whenever the quality metric exceeds the second threshold Q_{in} for minimum quality.

23. An apparatus as in claim 15, wherein the on periods and the off periods each correspond respectively to an on period and an off period of a duty cycle, and wherein at least one of the parameter values is changed from a broadcast or predetermined value by an amount that is based on the off period compared to a whole period of the on/off duty cycle.

24. A user equipment wireless communication terminal, comprising:

an apparatus as in claim 12; and

a transceiver for communicatively coupling with the radio access network, and configured to transmit to the radio access network.

25. A user equipment wireless communication terminal, comprising:

a radio front end;

a processor communicably coupled to the radio front end;
and

a memory coupled to the processor for storing a set of instructions, executable by the processor, wherein the instructions comprise:

determining on periods and off periods of a gated transmission in connection with receiving power control commands over a downlink channel of a radio access network;
and

varying a procedure used to determine when to declare a radio link failure based on the gated transmission by actually and/or effectively varying a quality measurement period used in the procedure or a parameter value used in the procedure.

26. A system comprising a user equipment wireless communication terminal as in claim 24 or claim 25 and a radio access network including a wireless terminal for communicably coupling to the user equipment wireless terminal by transmitting downlink signals to the user equipment wireless communication terminal and by receiving uplink signals from the user equipment wireless communication terminal.

27. A system as in claim 26, wherein the wireless terminal of the radio access network is configured to:

determine that the uplink signals are being transmitted according to a gated transmission; and

gate the downlink signals to correspond to the uplink gating.

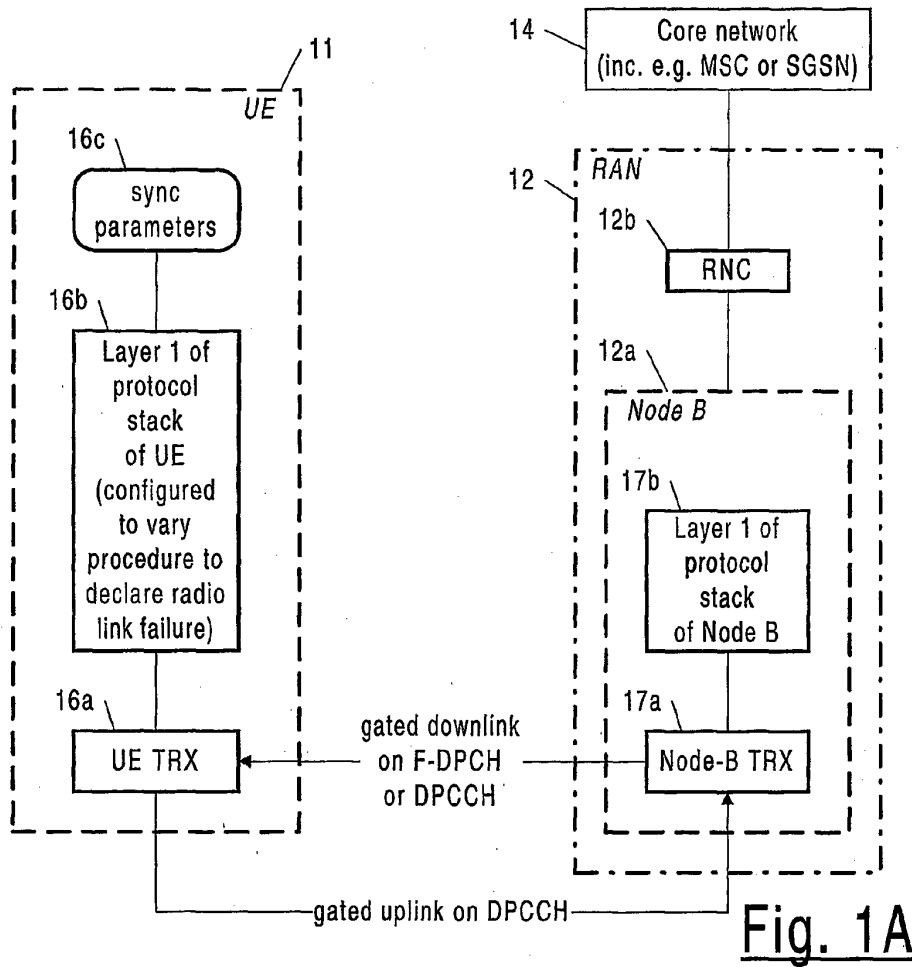


Fig. 1A

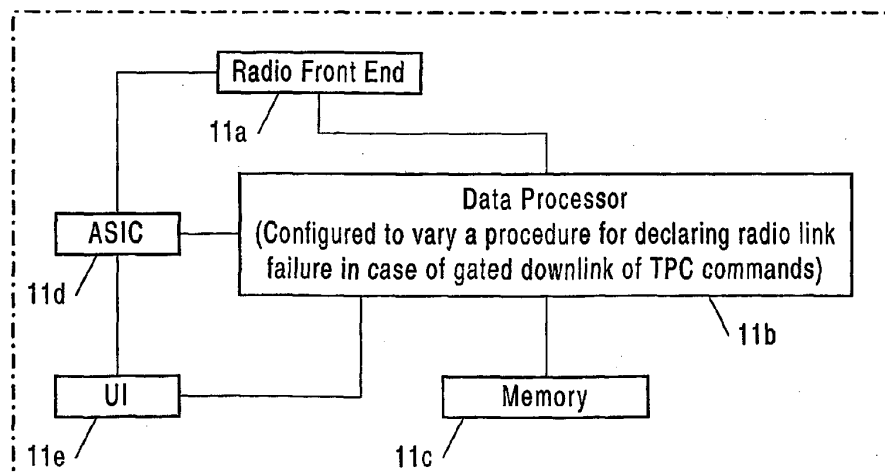
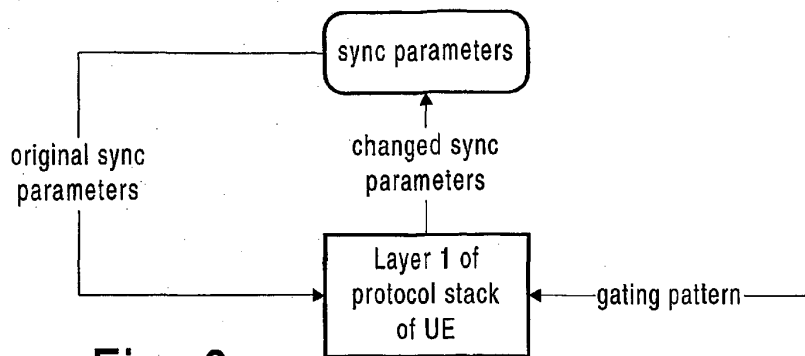
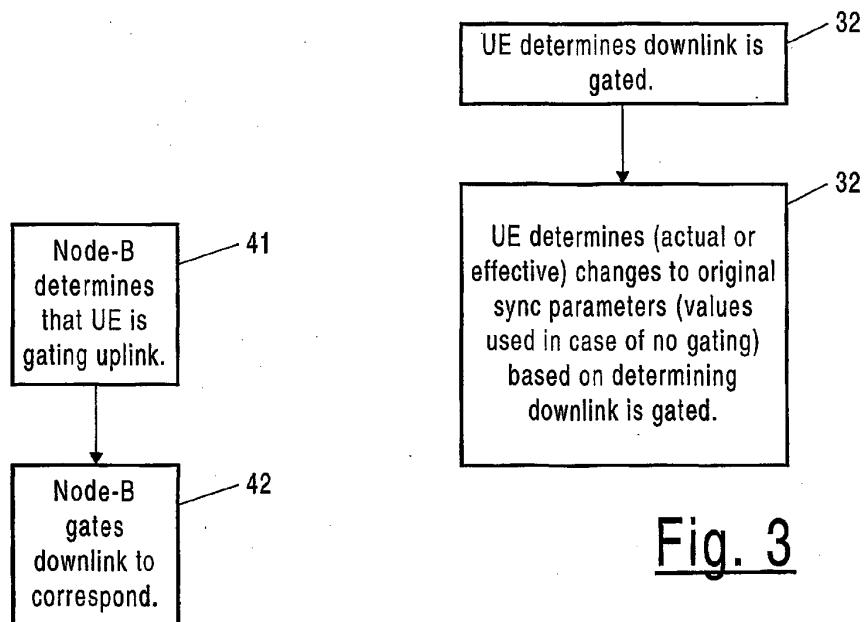


Fig. 1B

Fig. 2Fig. 3Fig. 4

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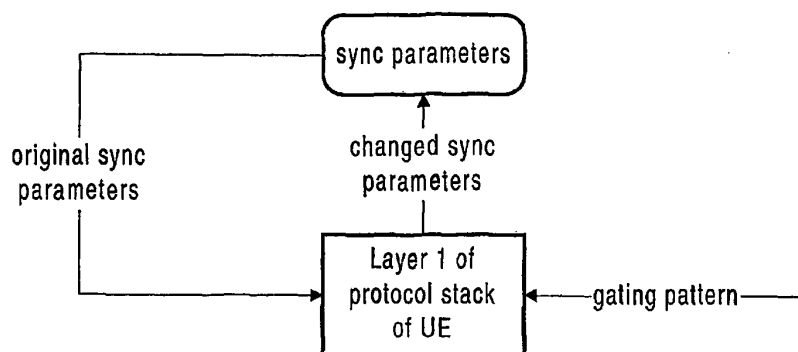
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OR DPCCH TRANSMISSION



(57) Abstract: A method and corresponding equipment by which a wireless terminal communicatively coupled to a radio access network adapts to gating in respect to a downlink signal from a radio access network carrying power control commands (e.g. the F-DPCH of UTRAN with WCDMA), including gating by the radio access network of either just the power control commands or the channel itself, or gating of reception of the power control commands by the user equipment. The adaptation can include changing values of parameters used in determining when the wireless terminal declares a radio link failure, or instead only changing the procedures used to determine whether a parameter value has been achieved and thus only effectively changing the parameter values (or one or more of the parameters can be actually and effectively changed).

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	3GPP TS 25.331 V6.9.0 (2006-03), paragraph 8.5.4, 8.5.6 --	1-27
A	3GPP TS 25.101 V6.11.0 (2006-03), 3rd Generation Partnership Project: Technical Specification Group Radio Access Network: User Equipment(UE) radio transmission and reception (FDD) (Release 6), paragraph 6.4.4 --	1-27
A	3GPP TS 25.214 V6.8.0 (2006-03), 3rd Generation Partnership Project: Technical Specification Radio Access Network: Physical layer procedures (FDD) (Release 6), page 9-page 13 --	1-27

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 1083678 A1 (LUCENT TECHNOLOGIES INC.), 14 March 2001 (14.03.2001), paragraphs [0013]-[0016] --	1-27
A	US 20020112288 A1 (LUNDBY, S ET AL), 15 August 2002 (15.08.2002), paragraphs [0025]-[0028],[0035]-[0037],[0045], figures 3B-C, claims 1-9, abstract --	1-27
A	US 6493541 B1 (GUNNARSSON, F ET AL), 10 December 2002 (10.12.2002), column 5, figure 8, abstract --	1-27
A	US 20050281222 A1 (RANTA-AHO, K ET AL), 22 December 2005 (22.12.2005), paragraph [0017], abstract --	1-27
A	3GPP TSG RAN2#47 Athens, Greece, 9-13 May, 2005. Change Request: "Faster L1 DCH synchronization". Paragraph 8.5.6 -- -----	1-27

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(54) Resource management method for multi access networks

(57) Every controller (RNC, BSC, E-NodeB, BS) of multi-RAT PLMN (UTRAN, GERAN, LTE, WIMAX) calculates for each controlled cell a MUB IE describing the availability of transport services in terms of maximum user bitrate that can currently be allowed to each transport service, separately for UL and DL, needed to plan usage of radio resources in the current and neighbouring cells, such as for handovers, cell reselections and new service setups. The MUB computation avails of:
-calculating an available capacity for a given service by taking a normalised capacity accessible to said service and by subtracting to it a normalized load of said service and of any other service that cannot be pre-empted by said service;

-calculating the MUBN for said service as the minimum between said available capacity and the maximum capacity MAXUB allowed to the single user for said service as a configuration setting;
-calculating a quantized representation MUB of the MUBN for said service as the nearest power of two raised at an integer n .

The MUB is included into management messages forwarded to the other controllers, either of the same or different technologies. Every controller checks the received MUB coming from the other controllers in order to decide on the most suited target cell, among the current and neighbouring cells, for resource management issues such as handover, cell reselection, and new service set-up (fig.6).

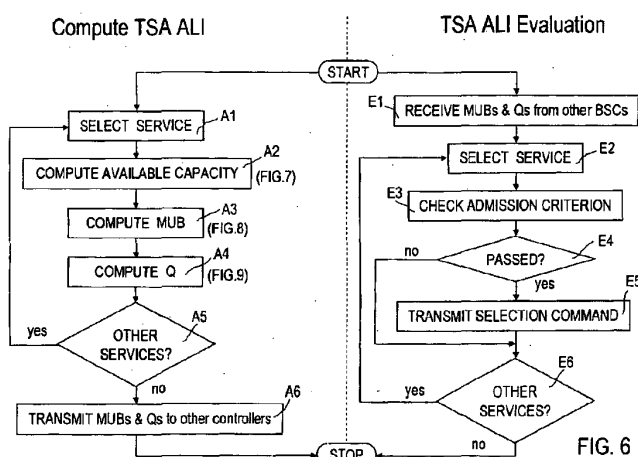


FIG. 6

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Description

FIELD OF THE INVENTION

- 5 **[0001]** The present invention relates to the so-called Ambient Networks (AN), and in particular to a resource management method for multi-access networks. (Used acronyms description and bibliographic references are given at the end of the description).

BACKGROUND ART

- 10 **[0002]** The communications industry has a truly historic opportunity over the coming years to connect the majority of the world using mobile, wireless broadband and fixed broadband systems. As a result, in 2015 we will live in a world, in which five billion people are connected, most of them 'always on' with a broadband connection. People can use the services they want anytime, anywhere with their preferred devices.

- 15 **[0003]** The Internet will be the dominant platform to connect these five billion people and their various devices with each other, and to provide access to a great variety of content and applications. Mobility will dominate in voice services with 70-90% of all traffic, depending on the market.

- [0004]** Broadband IP connections will be available practically anywhere in the world, across developed and growth markets. A combination of mobile, wireless and fixed systems will ensure global coverage, full mobility and adequate speed and capacity. In the growth markets mobile and wireless broadband will play a crucial role in broadband coverage.

- 20 **[0005]** In the converged telecom, Internet, media and IT landscape there will be a much larger variety of services providers and business models compared to today's telecom environment. Each provider will compete in a larger market than traditionally seen, creating both a huge opportunity and increased competition.

- [0006]** Taking into account said converged landscape, future internetworking will continue to signify "the interaction of heterogeneous networks", today including cellular, wireless and wire-line networks, public and private, belonging to users and operators. In this context the Ambient Networks project (see Ref. [1], [2], and [3] at the end) works for specifying a system capable to handle future internetworking by enabling dynamic composition of networks and establishment of inter-network agreements, coexistence of multiple access technologies, multi-operator and multi-hop functions, mobility and security support. The vision for multi-access operations is characterized by heterogeneous access technologies, radio or fixed, through which data may flow in series (multi-hop) or in parallel, alternatively or concurrently.

- [0007]** To enable multi-access operations, efficient resource management methods need to consider the diverse characteristics of the heterogeneous access technologies. This translates into the need to identify how the dissimilar access resources should be abstracted in order to provide the most suited building block for resource management operations, optimizing the trade-off between performance of the adopted resource management schemes, and cost of signalling and processing as contextualized in today's technologies. Started in January 2004 as part of the IST 6th Framework Programme of the European Union, the Ambient Networks project is developing a new networking environment providing thorough inter-working among today's networks, characterized by their diverse features and services. The objectives include enabling the emergence of new businesses, as well as stimulating continuous growth in the communication market.

- 40 **[0008]** Ambient Networks described in Ref.[3] realizes its objectives through the definition of a new network convergence layer, the "Ambient Control Space" (ACS), as a control stratum typically referred to as an overlay, where the envisaged Ambient Networks functionality is introduced. Open implementation options exist how this networking realm should be realized, while the main interfaces are under specification process.

- [0009]** Fig.1 schematizes a typical Ambient Network (AN) scenario characterised by the ACS as a control plane, and an Ambient Connectivity (ACY) functionality. The ACS includes a number of functionalities capable of managing Multi-radio Access, Context information, mobility, security and even more. The ACS includes interfaces towards the higher layers of control functionality, such as user applications through the Ambient Service Interface (ASI), and also includes Ambient Resource Interfaces (ARI) towards the ACY, i.e. the lower layers of control functionality. ANs and their respective ACSs interact through the ANI. ASI, ARI and ANI are logical interfaces that may run over heterogeneous communication means and access technologies.

- 50 **[0010]** The issue of multi-access in the ACS described in Ref.[4] mainly refers to criteria how resource management may handle communication paths of diverse access technology both in series and in parallel, alternatively or concurrently. For solving this issue, it is of primary importance to identify suitable abstractions of the access resource through which the ACS can view and control the "Ambient Connectivity" layers, where technology-specific communication paths are accessible via the "Ambient Resource Interface" (ARI). Fig.2 schematizes a process involving both ACS and Ambient connectivity in which technology-specific information needs to be abstracted up to a level and to a type that allows provisioning the envisaged multi-access operations in the ACS through respective algorithms. To this aim, "Abstracted (load) information" is defined as a more generic type of information, typically technology-independent, or quasi-technol-

ogy-independent, obtained by transformation through algorithms (abstraction layer algorithms) from a technology specific information. The goal is therefore not only defining the most suitable abstractions, but also providing the related mechanisms and algorithms for the technology-specific Abstraction Layers, together with the related access selection and admission control algorithms for the ACS.

[0011] Cell Capacity/load abstractions have been suggested up to now within discussions around load balancing in 3GPP for achieving a timely specification enabling some coordination between RNCs and BSCs. Cell load is a measurement typically easy to retrieve from parameters like total transmitted power, interference, number of occupied timeslots, etc.

[0012] "Transport Service Availability" (TSA) abstraction, limitedly to the bearer service, is disclosed in Patent application EP-A1-1503606 of the same inventors, which describes: a common radio resource management method in a mobile radio communication network employing different radio access technologies that overlap over a geographic area subdivided into cells belonging to the domains of respective controllers which are connected to each other in overlapping or adjacent domains and to a core network by means of relevant interfaces, suitable to be carried out for each controlled cell by the respective controller through the steps of:

- starting from acquired information about QoS and throughput of all the active connections with the served mobile terminals (UE/MS), calculating traffic-related Information Elements, separately for uplink and downlink, needed to plan handovers and/or cell reselections; said traffic-related Information Elements including indications of the availability of bearer services in the cell in terms of maximum bitrate, either guaranteed or not guaranteed, that can currently be allowed to each bearer service, said bearer service being distinguished by traffic class due to the different QoS characteristics of the bearer services in terms of Eb/No, error rates, priorities, and delay;
- including said traffic-related Information Elements in management messages forwarded to the controllers of different cells to the one in turn considered, either of the same or different technologies;
- checking said traffic-related Information Elements coming from the other controllers (BSC, RNC) in order to decide either of issuing or preventing handovers and/or cell reselection commands towards a neighbouring cell.

OUTLINED TECHNICAL PROBLEM

[0013] The teaching of the aforementioned document EP-A1-1503606 was only directed to announce the Bearer Service Availability as an exemplary abstraction based on Transport Service, but none other than reference to generic tables it is said of how calculating the Bearer Service Availability, so it is not currently known how to produce Transport Service Availability information elements. Without an effective criterion of how calculating said TSA, the access network controllers originating the information cannot "forecast" the outcome of the resident admission control algorithms for the specific service to be admitted.

OBJECT AND SUMMARY OF THE INVENTION

[0014] The main object of the present invention is that to overcome the lack of a clear teaching in the prior art of how calculating a transport service availability information element.

[0015] The invention achieves said object by providing a radio resource management method in a mobile radio communication network employing different radio access technologies, e.g.: UTRAN, GERAN, LTE, WiMAX, that overlap over a geographic area subdivided into cells belonging to the domains of respective controllers (RNC, BSC, E-NodeB, BS), including the following steps carried out by every controller for each controlled cell:

a) calculating a transport service availability information element, called hereafter MUB, describing the availability of transport services in terms of maximum user bitrate that can currently be allowed to each transport service, separately for uplink and downlink, needed to plan usage of radio resources in the current and neighbouring cells, such as for handovers, cell reselections and new service setups; the computation at step a) including at least the following substeps executed for each implemented service characterised by service type and high/low priority:

- a1) calculating an available capacity for a given service by taking a normalised capacity accessible to said service and by subtracting to it a normalized load of said service and of any other service that cannot be pre-empted by said service;
- a2) calculating the MUBN for said service as the minimum between said available capacity and the maximum capacity MAXUB allowed to the single user for said service as a configuration setting;
- a3) calculating a quantized representation MUB of the MUBN for said service for transmission over digital transmission means;

b) including said MUB information elements calculated as above into management messages forwarded to the other controllers, either of the same or different technologies;
 c) checking said MUB information elements coming from the other controllers (BSC, RNC, E-NodeB, BS) in order to decide on the most suited target cell, among the current and neighbouring cells, for resource management issues such as handover, cell reselection, and new service setup, as described in claim 1.

[0016] Details on the calculation and other aspects of the invention are described in the dependent claims.

[0017] A radio resource management method which avails of the precise teaching of how calculating TSA information according to the present invention, constitutes an effective improvement of the access selection and admission control algorithms in the control space of the Ambient Networks.

[0018] The smartness of the method has been tested by means of a comparative emulation applied to a GSM access network between TSA Abstraction Layer Information (ALI) calculated according to the method of the invention and 3GPP ALI based on Cell capacity/load. To the only aim of the emulation, some algorithms have been appositely developed also for calculating 3GPP (GSM) ALI and successively using it in evaluating some selection criteria of target cells for a given service.

[0019] Finally, a comparative algorithm between performances of two types of ALI has been developed for calculating the admission control error probability versus minimum cell load using 3GPP ALI instead of TSA ALI in emulating a GSM scenario characterized by a single target cell. The outcome of the comparative algorithm is the bunch of error curves reported in **fig.10** which clearly attests the superiority of TSA ALI calculated according to the method of the invention: typically, gains are higher for higher cell load, i.e. in the most critical situations.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] The invention and its advantages may be understood with reference to the following detailed description of an embodiment thereof taken in conjunction with the accompanying drawings given for purely non-limiting explanatory purposes and wherein:

- **fig.1** shows an Ambient Control Space and Connectivity diagram of the so-called Ambient Networks;
- **fig.2** schematized the mechanisms involved with the abstraction paradigm used at the ARI interface between ACS and Connectivity of **fig.1**;
- **fig.3** shows a known diagram of a Multi-RAT (GSM + 3G) PLMN as an exemplary scenario of Ambient Network;
- **fig.4** shows a very general diagram of the exchange of TSA Abstracted Load Information (ALI) calculated according to the method of the present invention, between a GSM controller and another Access Controller which performs TSA-based evaluation algorithms for traffic planning inside the network of **fig.3**;
- **fig.5** shows a very general diagram which differs from the previous one for the additional exchange of traditional 3GPP ALI based on capacity/load, so at the other Access Controller two evaluation algorithms for access selection can be compared to each other in order to calculate the evaluation error of the 3GPP ALI approach in respect of more correct evaluations performed by the algorithm which makes use of TSA ALI calculated according to the method of the invention;
- **fig.6** is the most general flow chart of GSM abstraction layer for computation of TSA ALI and concurrent execution of TSA ALI evaluation for admission control according to the method of the invention;
- **figures 7, 8, and 9** are flow charts relevant to corresponding steps of the flow chart of **fig.6**;
- **fig.10** shows a bunch of 3GPP ALI error curves versus minimum cell load (plotted for various services) in taking cell selection decisions comparatively based on both 3GPP ALI and TSA ALI, when the GSM scenario of **fig.5** is emulated limitedly to a single target cell;
- **fig.11** shows an evolution of the Multi-RAT PLMN depicted in **fig.3** as a future candidate to host the present invention;
- **fig.12** shows a diagram of inter E-Node B communication according to 3GPP Long Term Evolution (LTE) Access Network as another candidate to host the present invention;
- **fig.13** shows a similar diagram for a WiMAX Access Network as still another candidate to host the present invention.

DETAILED DESCRIPTION OF AN EMBODIMENT OF THE INVENTION

[0021] **Fig.3** shows a multi-RAT (Radio Access Technology) PLMN that will be soon completed in Europe. The new Universal Mobile Telecommunications System (UMTS) shares the existing GSM (Global System for Mobile communications) Core Network CN with the GPRS service. Relevant GSM RAN (Radio Access Network) in **fig.3** is the so-called GERAN (GSM EDGE RAN), corresponding to the ultimate GSM RAN based on new EDGE (Enhanced Data rates for GSM Evolution) techniques that allow higher data rates in GSM, e.g. higher modulations. The Core Network CN is connected to one or more BSS (Base Station Subsystem) of the GSM, and to one or more RNS (Radio Network

Subsystem) of an UTRAN (Universal Terrestrial Radio Access Network). The UMTS system of fig.3 is described in the TS 23.002 (CN) and TS 25.401 (UTRAN). Both the UTRAN and BSS are connected, on air, to a plurality of User Equipment UE/MS, each including a Mobile Equipment ME with a respective USIM card (UMTS Subscriber Identity Module). The present invention applies to UEs of single but preferably multistandard type: so that they are indicated as UE/MS (without limitation, often the only term UE is indicated). The UTRAN includes a plurality of Node B blocks each connected to a respective Radio Network Controller RNC by means of an Iub interface. A node B includes a Base Transceiver Station BTS connected to the UEs through an on-air Uu interface. The upper RNC is a Serving S-RNC connected to the Core Network CN by means of a first Iu(CS) interface for Circuits Switched and a second Iu(PS) interface for Packet Switched of the GPRS. It is also connected to an Operation and Maintenance Centre (OMC). The RNC placed below can be a Drift D-RNC and is connected to the upper S-RNC by means of an Iur interface. The UTRAN with the served UEs constitute a Radio Network Subsystem (RNS) disclosed in TS 23.110.

[0022] The GSM - BSS block includes a plurality of BTSs connected to a Base Station Controller BSC by means of an Abis interface and to the UEs through an on-air Um interface. The BSC is interfaced to the Core Network CN by means of a Gb interface (packet switched) and is further connected to a Transcoder and Rate Adaptor Unit TRAU also connected to the Core Network CN through an A interface. It is also connected to an Operation and Maintenance Centre (OMC).

[0023] The CN network includes the following Network Elements: Switching Centre MSC / Visitor Location Register VLR, Gateway MSC GMSC, Interworking Function IWF / Transcoder TC, Camel Service Environment CSE, Equipment Identity Register EIR, Home Location Register HLR, Authentication Centre AuC, Serving GPRS Support Node SGSN, and Gateway GPRS Support Node GGSN. The following interfaces are visible inside the CN block: A, E, Gs, F, C, D, Gf, Gr, Gc, Gn, and Gi. The IWF block translates the Iu(CS) interface into the A interface towards MSC / VLR block. The TC element performs the transcoding function for speech compression/expansion concerning UTRAN (differently from GSM where this function is performed outside the CN network) also connected to the MSC block through the A interface. The GMSC is connected to the MSC / VLR through the E interface and to a Public Switched Telephone Network PSTN and an Integrated Services Digital Network ISDN. Blocks CSE, EIR, HLR, AuC are connected to the MSC / VLR through, in order, the Gs, F, C, and D interfaces, and to the SGSN node through the Gf and Gr interfaces. The SGSN block is interfaced at one side to the S-RNC inside UTRAN block by means of the Iu(PS) interface, and to the BSC inside the GSM-BSS block through the Gb interface. At the other side the SGSN node is interfaced to the GGSN node through the Gn interface. The last block is connected through the Gi interface to a packet data switching network of the IP (Internet Protocol) type and/or the X.25 type. The Core Network CN of fig.3 consists of an enhanced GSM Phase 2+, as described in TS 23.101, with a Circuit Switched CS part and a packet Switched part (GPRS). Another important Phase 2+ is the CAMEL (Customised Application for Mobile network Enhanced Logic) Application Part (CAP) used between the MSC and CSE for Intelligent Network (IN) applications. CAP is described in TS 29.078.

[0024] In operation, the MSC, so as the SGSN node, keep records of the individual locations of the mobiles and performs the safety and access control functions. More BSS and RNS blocks are connected to the CN Network, which is able to perform intrasystem handovers between adjacent RNSs or between adjacent BSSs, and intersystem handovers between a RNS and an adjacent BSS. UTRAN in respect of GSM further improves data service by making possible greater throughputs and the asymmetrical traffic typical of the Internet Protocol (IP). The network of fig.3, which only represents a minimal part of a world-wide network, shall allow the routing of a telephone call inside an International UMTS / GSM Service Area subdivided into National Service Areas. By way of the hierarchical structure of the network, each National Service Area is subdivided into the following nested domains of decreasing area: PLMN Service Area; MSC / SGSN Service Area; Location Area LA (CS-domain) uniquely defined by its LAI (Location Area Identity) code; Routing Area RA inside the SGSN Service Area as a partition of the CS Location Area; Cell Area where the UE is actually located in the radio coverage of a target Node B or BTS. Many known protocols described in the relevant standardization are deputed to govern the exchange of information at the various interfaces.

[0025] To the aim of the present invention the multi-RAT network of fig.3 is a particular embodiment of the Ambient Network of fig.1 whose controllers RNC and BSC are capable of handling TSA ALI calculated as will be described soon. More in particular, the functional blocks indicated in figures 4 and 5 are mapped in the network of fig.3.

[0026] Referring also to figures 11 to 13 for what concerns the SAE/LTE and WiMAX technologies, this figures being explained later in detail, we describe a method where different access technologies (including UTRAN, GERAN, LTE and WiMAX) totally or partially overlapping over a geographic area, or having respective neighbouring cells, are coordinated through their respective controllers (RNC, BSC, E-NodeB, BS, ...) for the sake of handovers, cell reselections and new service setups. The method is based on the calculation, exchange and evaluation of TSA information, including indication of the maximum user bitrate (MUB) and quantity (Q) that can currently be allowed to the single user for each service.

[0027] Now with reference to the figures 6 to 9 a TSA ALI computation algorithm is described limitedly to the GSM case for the BSC, but this shouldn't constitute a bar for the skilled in the art in adapting the algorithm to the UTRAN or other RAT networks. Parallely to the description of the TSA ALI computation algorithm a 3GPP ALI computation algorithm

is described to the only aim of comparison between the twos and without dedicated figures.

[0028] We consider for GSM a number of transport service types including conversational circuit-switched services, Enhanced GPRS streaming services, non-real-time GPRS services and non-real-time Enhanced GPRS services. Also, we consider different service priorities for a portion of the described service types: in particular we consider as higher priority services the ones in handover, and as lower priority services any new service setup request.

[0029] We start describing the algorithm for computing the TSA information described in **fig.6 (leftmost part)**. For each service (**fig.6**, steps A1 and A5), characterised by service type and service priority, we compute the available capacity (step A2), then we compute the MUB (step A3) and finally we compute the additional element Q (step A4) describing the quantity of available services at the bitrate indicated by MUB.

[0030] For computing the available capacity for a given service, we start by computing the accessible capacity to that service, which equals at first the total fixed cell capacity. However, when taking into account reserved capacities for different services, the accessible capacity for that service needs to exclude any capacity reserved to other services, for example resources reserved to circuit switched and/or packet switched services (**fig.7** step C1). In particular, reserved resources can be dynamically set in time according to policies, current resource usage and resource bookings.

[0031] Moreover, the accessible capacity is either all capacity accessible to the given service type for the highest service priority of that service, or a percentage of all capacity accessible to the given service type according to a respective load threshold set for lower service priorities (**fig.7** steps C2 and C3). When taking into account reserved capacities for different services, load thresholds for lower service priorities can be set on the reserved and shared capacities limiting the accessible capacity for those service priorities accordingly to a related portion.

[0032] Having computed the accessible capacity, its current occupation in terms of load needs to be considered. When there exist non-guaranteed resources given as a surplus resource to any service, the guaranteed load of any service needs to be computed as the current load in the portion required for providing a guaranteed Quality of Service, excluding any surplus resource currently allocated (**fig.7** step C4).

[0033] The available capacity for a given service is then computed (**fig.7** step C5) by taking the capacity accessible to the service and by subtracting to it the guaranteed load of that service and of any other service that cannot be pre-empted by that service. When taking into account reserved capacities for different services, the load of any other service that cannot be pre-empted by that service would be considered only in the portion of allocation into the capacity accessible to that service. Finally, when taking into account additional control signalling load, the available capacity for a given service would need not to include the capacity allocated for control signalling in the portion of allocation into the capacity accessible to that service.

[0034] The available capacity, together with the accessible capacity and the load of different services, can be computed in a number of ways, for example as a bitrate indication or a pure number. When computing it as a bitrate indication a normalisation criteria is required: for example for any service the capacity available can be computed first as a gross normalised bitrate as if the capacity available would be used by a reference service (e.g. voice), and only in a second step the capacity available can be expressed as net user bitrate through a conversion factor (**fig.7** step C6).

[0035] Once computed the available capacity for a given service, taking into account the maximum capacity MAXUB allowed to the single user for that service as a configuration setting, the algorithm needs to compute MUBN as the minimum between the available capacity and MAXUB (**fig.8** step M1). In particular, MAXUB can be dynamically set in time as a function of the available capacity. The algorithm then computes for the given service the TSA parameter MUB as a quantized representation of MUBN, for the sake of transmission over digital transmission means (**fig.8** step M2). This can be done in a number of ways, e.g. by taking the Integer part of MUBN, or by taking the nearest power of two raised at an integer n .

[0036] Once computed MUB, and in particular MUBN, the algorithm computes QN describing the number of available services of bitrate MUBN as the ratio between the available capacity and MUBN (**fig.9** step Q1). Finally the algorithm computes for the given service the TSA parameter Q as a quantized representation of QN, for the sake of transmission over digital transmission means (**fig.9** step Q2). This can be done e.g. through thresholds on QN distinguishing a number of quantity levels.

[0037] When TSA is computed for each service of interest in terms of MUB and Q, this information is passed to other access controllers (**fig.6** step A6), which on need will use this information for performing access selection for a given service (**fig.6** step E1).

[0038] With regards to the access selection algorithms, **fig.6 (rightmost part)** describes the undertaken steps. First of all, a service is selected (**fig.6** step E2) for which an access selection decision needs to be taken, based e.g. on handover/cell reselection needs, new service requests and load management needs.

[0039] Regarding the access selection criterion (**fig.6** step E3) there exist two cases: the case where a single cell is evaluated as a potential target, and the case where two or more cells are compared as potential targets. In both cases the algorithms need to take the TSA information corresponding to that service. In the former case the algorithm needs then to check if the MUB information indicates the availability of the required bitrate for that service, in which case the cell is a suitable target cell. In the latter case instead the algorithm needs then to check if the MUB information indicates

the availability of the required bitrate for that service in each cell, in which case the cells satisfying this requirement are suitable target cells, and if required finally check the Q information element of the different suitable target cells for selecting the cell with highest Q as the best target cell.

- 5 [0040] If a target cell could be selected (fig.6 step E4), a selection command is transmitted (fig.6 step E5), triggering e.g. handover/cell reselection requests of service setup requests towards the target cell. Concluding, the algorithm may be repeated for any additional service requiring access selection (fig.6 step E6).

General assumptions

10 [0041]

- UUDL: in general, similar parameters and characteristics apply for uplink and downlink. For simplicity we refer e.g. to only DL for calculation and evaluation of the TSA, although similar work should be done for UL. Also, an aggregated figure could be obtained for UL and DL by combining the TSA for UL and DL.
- 15 - there exist resources reserved for different services (voice, GPRS) and priorities (voice handover), and/or vendor specific thresholds (e.g. new calls will be accepted only under 75% load). We assume for simplicity that for each service dedicated (reserved) resources are filled first, i.e. that the system can be configured as such.
- 20 - there exists a varying capacity occupied by signalling and other overheads (broadcast channels, coding, signalling for call setup, ...)
- there exist surplus resources, i.e. resources that are given to the user as a surplus, i.e. above the guaranteed bitrate, under favourable conditions. This exists only for RT services, as for NRT nothing is guaranteed. E.g. it considers the allocation of full-rate codecs or high-quality AMR codecs, that can be given under favourable load conditions, but which availability cannot be guaranteed.
- 25 - there exist different classes of terminals with different values for max throughput that can be provided to the user. Also, due to particular interference conditions, different terminals may adopt more or less favourable coding schemes. Still, we don't use these assumptions because the described realization of TSA is agnostic of the specific user exploiting the service.
- 30

DEFINITION OF ABSTRACTED RESOURCES

35 GSM Resource Status (RS)

[0042] The following characterization is defined in order to build the abstraction layers on something concrete. The information elements presented have the following requirements:

- 40 • They need to represent technology-specific resource abstractions.
- They need to significantly describe the status of the resources.
- They need to be obtainable, i.e. it must be possible to calculate them through specific modules.

45

[0043] We characterize GSM resource status (RS) as follows:

- C: a total fixed capacity, depending on the number of TRX/channels, in normalised kbit/s (normalised for a typical channel, e.g. voice under normal conditions - gross occupancy) [182.4 .. 8755.2 kbit/s]
- 50 - C(C), C(P): set of resources reserved to circuit (C) and packet (P) services [0 .. 8755.2 kbit/s]
- L: load parameter in normalised kbit/s indicating the gross total occupancy [0 .. 8755.2 kbit/s]
- 55 - L(RTC): load parameter in normalised kbit/s indicating the gross occupancy due to circuit RT services (voice) [0 .. 8755.2 kbit/s]
- L(RTP): load parameter in normalised kbit/s indicating the gross occupancy due to packet RT services (streaming)