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21912
VAN PELT, YI & JAMES LLP
10050 N. FOOTHILL BLVD #200
CUPERTINO, CA 95014

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Applicant(s)

Gregory G. Raleigh, Woodside, CA;

Power of Attorney:

Michael Schallopp--44319

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Title

ENTERPRISE AND CONSUMER BILLING ALLOCATION FOR WIRELESS COMMUNICATION
DEVICE SERVICE USAGE ACTIVITIES

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Attorney Docket No. RALEP037+

PROVISIONAL APPLICATION FOR UNITED STATES PATENT

**ENTERPRISE AND CONSUMER BILLING ALLOCATION FOR
WIRELESS COMMUNICATION DEVICE SERVICE USAGE ACTIVITIES**

By Inventor(s):

Gregory G. Raleigh
Woodside, CA
A Citizen of the United States

Assignee: Headwater Partners I LLC, a Delaware limited liability company

VAN PELT, YI & JAMES LLP
10050 N. Foothill Blvd., Suite 200
Cupertino, CA 95014
Telephone (408) 973-2585

ENTERPRISE AND CONSUMER BILLING ALLOCATION FOR WIRELESS COMMUNICATION DEVICE SERVICE USAGE ACTIVITIES

BACKGROUND OF THE INVENTION

[0001] With the advent of mass market digital communications and content distribution, many access networks such as wireless networks, cable networks and DSL (Digital Subscriber Line) networks are pressed for user capacity, with, for example, EVDO (Evolution-Data Optimized), HSPA (High Speed Packet Access), LTE (Long Term Evolution), WiMax (Worldwide Interoperability for Microwave Access), and Wi-Fi (Wireless Fidelity) wireless networks increasingly becoming user capacity constrained. Although wireless network capacity will increase with new higher capacity wireless radio access technologies, such as MIMO (Multiple-Input Multiple-Output), and with more frequency spectrum being deployed in the future, these capacity gains are likely to be less than what is required to meet growing digital networking demand.

[0002] Similarly, although wire line access networks, such as cable and DSL, can have higher average capacity per user, wire line user service consumption habits are trending toward very high bandwidth applications that can quickly consume the available capacity and degrade overall network service experience. Because some components of service provider costs go up with increasing bandwidth, this trend will also negatively impact service provider profits.

BRIEF DESCRIPTION OF THE DRAWINGS

[0003] Various embodiments of the invention are disclosed in the following detailed description and the accompanying drawings.

[0004] **Figure 1** illustrates a functional diagram of a network architecture for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

[0005] **Figure 2** illustrates a functional diagram of another network architecture for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

[0006] **Figure 3** illustrates a functional diagram of another network architecture for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

[0007] **Figure 4** illustrates a functional diagram of another network architecture for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

[0008] **Figure 5** illustrates a functional diagram of another network architecture for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

[0009] **Figure 6** illustrates a functional diagram of another network architecture for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

[0010] **Figure 7** illustrates a functional diagram of another network architecture for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

[0011] **Figure 8** illustrates a functional diagram of another network architecture for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

[0012] **Figure 9** illustrates a functional diagram of another network architecture for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

[0013] **Figure 10** illustrates a functional diagram of another network architecture for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

[0014] **Figure 11** illustrates a functional diagram of another network architecture for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

[0015] **Figure 12** illustrates a functional diagram of another network architecture for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

[0016] **Figure 13** illustrates a functional diagram of a secure device application architecture for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

[0017] **Figure 14** illustrates a functional diagram of another secure device virtual machine architecture for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

[0018] **Figure 15** illustrates a functional diagram of another secure device hardware execution partition architecture for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

[0019] **Figure 16** illustrates a functional diagram of another secure device service processor architecture for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

[0020] **Figure 17** illustrates a functional diagram of another network architecture for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

[0021] **Figure 18** illustrates a functional diagram of another network architecture for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

[0022] **Figure 19** illustrates a functional diagram of another network architecture for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

[0023] **Figure 20** illustrates a functional diagram of another network architecture for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

[0024] **Figure 21** illustrates a functional diagram of another network architecture for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

[0025] **Figure 22** illustrates a functional diagram of another network architecture for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

[0026] **Figure 23** illustrates a functional diagram of a secure device application architecture with device based service usage monitoring for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

[0027] **Figure 24** illustrates a functional diagram of a secure device virtual machine architecture with device based service usage monitoring for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

[0028] **Figure 25** illustrates a functional diagram of a secure device hardware execution partition architecture with device based service usage monitoring for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

[0029] **Figure 26** illustrates a functional diagram of a secure device service processor architecture with device based service usage monitoring for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

[0030] **Figure 27** illustrates a flow diagram for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

[0031] **Figure 28** illustrates another flow diagram for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

[0032] **Figure 29** illustrates another flow diagram for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

[0033] **Figure 30** illustrates another flow diagram for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments.

DETAILED DESCRIPTION

[0034] The invention can be implemented in numerous ways, including as a process; an apparatus; a system; a composition of matter; a computer program product embodied on a computer readable storage medium; and/or a processor, such as a processor configured to execute instructions stored on and/or provided by a memory coupled to the processor. In this specification, these implementations, or any other form that the invention may take, may be referred to as techniques. In general, the order of the steps of disclosed processes may be altered within the scope of the invention. Unless stated otherwise, a component such as a processor or a memory described as being configured to perform a task may be implemented as a general component that is temporarily configured to perform the task at a given time or a specific component that is manufactured to perform the task. As used herein, the term ‘processor’ refers to one or more devices, circuits, and/or processing cores configured to process data, such as computer program instructions.

[0035] A detailed description of one or more embodiments of the invention is provided below along with accompanying figures that illustrate the principles of the invention. The invention is described in connection with such embodiments, but the invention is not limited to any embodiment. The scope of the invention is limited only by the claims and the invention encompasses numerous alternatives, modifications and equivalents. Numerous specific details are set forth in the following description in order to provide a thorough understanding of the invention. These details are provided for the purpose of example and the invention may be practiced according to the claims without some or all of these specific details. For the purpose of clarity, technical material that is known in the technical fields related to the invention has not been described in detail so that the invention is not unnecessarily obscured.

[0036] Some enterprises only allow certain specialized wireless devices to be used for connection to their enterprise network. Such devices typically contain secure data storage and enterprise program execution environments to protect enterprise information and network access. This approach is generally directed towards maintaining enterprise data integrity and enterprise network security. However, this approach does not address the various problems associated with

allocating service usage or billing between consumer or non-enterprise service usage activities and enterprise service usage activities.

[0037] Accordingly, there is a need to provide for an enterprise and consumer billing allocation for wireless communication device service usage activities. There is also a need to address various issues with enterprise policies that can vary from employee to employee. For example, roaming policies can be configured differently for a global sales person than for a finance administrator who does not travel as much on enterprise business. Furthermore, some enterprises may not elect to pay for employee wireless communication device purchase or all employee wireless communication service usage needs or desires. As a result, some enterprises would benefit from techniques that allowed such enterprises to piggy back on consumer device or service purchases while maintaining an enterprise and consumer billing allocation for wireless communication device service usage activities.

[0038] Also, some consumers prefer to select their own wireless communication device that may not be an enterprise approved wireless communication device or a specialized enterprise device specified by enterprise IT managers. For example, certain enterprises may only offer certain Blackberry smart phone devices, and certain employees may prefer Apple iPhone and/or various Android based smart phone devices. Another trend suggests that a growing number of enterprise employees desire to use a single wireless communication device for their enterprise mobile communication, enterprise information access, and enterprise network access as well as for, for example, their personal mobile communication, access, and application needs (e.g., consumer/personal, that is, non-enterprise, use of cellular calls, text messaging, web browsing, social networking, games, and various other service usage activities).

[0039] As a result, enterprise network managers generally need a way to safely allow consumers to perform consumer mobile access services that the enterprise can specify that will not be paid for by the enterprise. Various network architectures and techniques are described herein that allow an enterprise to determine how much service usage (e.g., or how much of a corresponding service bill) should be allocated to device user services or consumer services and how much should be allocated to enterprise services in which the enterprise sponsors the enterprise access. Various design approaches and techniques are described herein for allocating

enterprise and consumer billing in a secure manner that works with both specialized enterprise wireless communication devices as well as other wireless communication devices. For example, crediting a user bill with sponsored enterprise service usage is provided using various techniques described herein. As another example, providing enterprise employee reimbursement for enterprise services used on the employee wireless communication device or allowing an enterprise to deduct employee consumer service usage from their paycheck is provided using various techniques described herein. As yet another example, allowing a consumer to select from an instant activation platform on a wireless communication device that comes pre-loaded with various enterprise services is provided using various techniques described herein. As yet a further example, providing for a capability to install or download an enterprise application that provides secure enterprise mobile services access and allocating enterprise and consumer billing for consumer wireless communication devices is provided using various techniques described herein.

[0040] Various techniques for monitoring service usage and providing for secured and verifiable device assisted services (DAS), including DAS based service usage monitoring, are disclosed in co-pending U.S. Patent Application No. 12/380,758 (Attorney Docket No. RALEP003), entitled VERIFIABLE DEVICE ASSISTED SERVICE USAGE MONITORING WITH REPORTING, SYNCHRONIZATION, AND NOTIFICATION, filed on March 2, 2009, published as U.S. Pub. App. No. 20100191612, co-pending U.S. Patent Application No. 12/695,019 (Attorney Docket No. RALEP022), entitled DEVICE ASSISTED CDR CREATION, AGGREGATION, MEDIATION and BILLING, filed on January 27, 2010, published as U.S. Pub. App. No. 20100197266, co-pending U.S. Patent Application No. 12/695,020 (Attorney Docket No. RALEP024), entitled ADAPTIVE AMBIENT SERVICES, filed on January 27, 2010, published as U.S. Pub. App. No. 20100198698, co-pending U.S. Patent Application No. 12/694,445 (Attorney Docket No. RALEP025), entitled SECURITY TECHNIQUES FOR DEVICE ASSISTED SERVICES, filed on January 27, 2010, published as U.S. Pub. App. No. 20100199325, co-pending U.S. Patent Application No. 12/694,451 (Attorney Docket No. RALEP026), entitled DEVICE GROUP PARTITIONS AND SETTLEMENT PLATFORM, filed on January 27, 2010, published as U.S. Pub. App. No. 20100197267, which are incorporated herein by reference for all purposes.

[0041] In some embodiments, allocating enterprise and consumer billing for service usage activities on a wireless communication device is provided for service usage activities that an enterprise configures as approved and/or sponsored for enterprise billing (e.g., such service usage activities are paid for at least in part by the enterprise) and consumer applications and service usage activities that the device user chooses to use from the wireless communication device and that the enterprise does not sponsor. Various embodiments are disclosed herein describing a wide range of devices that users and enterprises may desire to use for such dual purpose application scenarios. In some embodiments, devices for such applications can include a less specialized and secure device program execution environment as further described herein.

[0042] Accordingly, enterprise and consumer billing allocation for wireless communication device service usage activities is provided. In some embodiments, enterprise and consumer billing allocation for wireless communication device service usage activities includes monitoring a service usage activity of a wireless communication device (e.g., the monitoring can be performed in the wireless communication device and/or the monitoring of enterprise application service usage can be performed using a secure application server in the enterprise network), and determining an enterprise and consumer billing allocation for the monitored service usage activity. In some embodiments the allocation is determined by classifying the service usage activities as associated with a consumer service usage activity (e.g., in a consumer service usage activity list) or associated with an enterprise service usage activity (e.g., in an enterprise service usage activity list; or, as another example, if the monitored service usage activity is not included in the enterprise service usage activity list, then it can be automatically classified as a consumer service usage activity by default).

[0043] In some embodiments, enterprise and consumer billing allocation for wireless communication device service usage activities includes providing a service design center (SDC) for configuring an enterprise and consumer billing allocation of monitored service usage activities for a plurality of wireless communication devices associated with an enterprise account, and implementing the configured enterprise and consumer billing allocation for monitored service usage activities for the plurality of wireless communication devices associated with the enterprise account.

[0044] In some embodiments, enterprise and consumer billing allocation for wireless communication device service usage activities includes monitoring service usage of a wireless communication device, and determining whether a user is acting as a consumer (e.g., personal service usage activities on the wireless communication device) or a professional (e.g., enterprise service usage activities on the wireless communication device, that is, the user is working on the wireless communication device in their capacity as an employee for an enterprise, in which the wireless communication device is associated with an enterprise account for the enterprise) based on the monitored service usage activity (e.g., based on place, time of day, application or service activity, and/or other criteria or factors). In some embodiments, enterprise and consumer billing allocation for wireless communication device service usage activities differentially charges and/or allocates billing between the enterprise and the consumer based on a classification of the monitored service usage activity as allocated to the enterprise or to the consumer for billing/charging purposes.

[0045] In some embodiments, enterprise and consumer billing allocation for wireless communication device service usage activities includes monitoring a service usage activity of a wireless communication device, and reporting the monitored service usage activity to a network element (e.g., a service controller, a service usage reconciliation function or other service control or billing/charging function in the network), in which the network element determines an enterprise and consumer billing allocation for the monitored service usage activity. In some embodiments, the network element (e.g., or another network element) determines an enterprise and consumer billing allocation for the monitored service usage activity. In some embodiments a service usage reconciliation function determines how much service usage is due to enterprise service usage activities and how much is due to consumer service usage activities. In some embodiments, after determining the allocation between consumer and enterprise service usage activities, the service usage reconciliation function provides the information to a service usage accounting function (e.g., a carrier billing server or an enterprise service usage accounting server), which in turn delivers a consumer usage report or bill and/or an enterprise usage report or bill. In some embodiments, the service usage reconciliation function determines the amount of enterprise service usage and creates a service usage credit record so that a device user's account can be credited or a device user can be compensated or reimbursed for enterprise service usage costs. In some embodiments, a service usage monitor is configured to monitor service

usage activities of a device. In some embodiments, the service usage monitor is configured to classify the monitored service usage activities as enterprise service usage activities. In some embodiments, the service usage monitor is configured to classify the monitored service usage activities as consumer service usage activities. In some embodiments, the service usage monitor is configured to monitor a first group of service usage activities for service usage allocation to a device user (e.g., using a list of service usage activities associated with a consumer service usage), and a second group of service usage activities for service usage allocation to an enterprise (e.g., using a list of service usage activities associated with an enterprise service usage). In some embodiments, service usage activities (e.g., service activities, such as applications, network, and/or voice based activities that use wireless network service usage resources) are classified using various techniques described herein, such as based on application (e.g., application credential), device (e.g., device credential), time of day, network destination, network traffic protocol and/or port, and various other criteria/factors. In some embodiments, the service usage monitor is implemented in the network (e.g., on one or more network elements in the carrier network and/or enterprise network, as described herein). In some embodiments, the service usage monitor is implemented in the device (e.g., using various techniques described herein, including verifiable and/or secured based implementations). In some embodiments, the service usage monitor is implemented using both network based and DAS based techniques, as described herein with respect to various embodiments.

[0046] In some embodiments, a set of service activities that will be sponsored by an enterprise (e.g., a specified or configured list of enterprise sponsored service activities) is managed by an enterprise service design center. In some embodiments, a list of service activities and the associated service policies for each service activity are compiled to form an enterprise sponsored service activity policy set. For example, enterprise email, enterprise calendar, and enterprise contacts can be configured as sponsored service activities. In some embodiments, the sponsored enterprise services list includes a list of network destinations that are associated with the services (e.g., an enterprise mail server address and/or an enterprise internal corporate network). For example, the enterprise email can be a sponsored service that is associated with an enterprise sponsored email service policy, which can limit destinations for corporate email, sizes of emails and/or email attachments, and/or other email related usage criteria or factors (e.g., a service usage charging policy).

[0047] In some embodiments, the monitored service usage is reported to the reconciliation function by a carrier network service usage monitoring element (e.g., a home agent (HA), access network gateway, or other network element, such as a deep packet inspection (DPI) function). In some embodiments, the monitored service usage is reported to the reconciliation function by an enterprise network service usage monitoring element (e.g., a carrier network gateway or a mobile services gateway/server or other element in the enterprise network that can measure service usage and associate it with a given device credential or application credential). In some embodiments, the monitored service usage is reported to the reconciliation function by an element in the mobile device (e.g., a service usage monitor in a secure enterprise mobile services application or a Service Processor function, which can be securely implemented and/or verified using various techniques described herein).

[0048] In some embodiments, a service design center for implementing enterprise and consumer billing allocation for wireless communication device service usage activities is provided. For example, an enterprise manager can use the service design center to select one or more services that the enterprise agrees to pay for/is responsible for paying for and to select one or more other services that the employees of the enterprise must agree to pay for/are responsible for paying for (e.g., if the employee elects to use/have such services that are not charged to the enterprise, included as enterprise services that are charged to or paid for by the enterprise).

[0049] In some embodiments, a service design center that facilitates configuration of sponsored enterprise services for implementing enterprise and consumer billing allocation for wireless communication device service usage activities is provided. In some embodiments, a service design center for implementing enterprise and consumer billing allocation for wireless communication device service usage activities includes providing a service design center for a carrier network and another service design center for an enterprise network (e.g., in some cases, these service design centers can be combined).

[0050] In some embodiments, an enterprise sponsored service activity policy set is created by an enterprise network administrator with an enterprise service design center user interface (UI). In some embodiments, the enterprise sponsored service activity policy set includes a list of network destination addresses that corresponds to the desired sponsored service

activity list, along with an access policy or service usage charging policy for the service activities. In some embodiments, all service activities in the enterprise sponsored service activity policy set receive the same access policies or charging policies. In some embodiments, a first subset of one or more of the service activities in the enterprise sponsored service activity policy set receive access policies or charging policies that are different than that of a second subset of service activities. For example, a sponsored enterprise email service can be in the first subset, and sponsored mobile voice services can be in the second subset, as certain employees (e.g., traveling sales personnel and/or executives) can be granted international and/or roaming mobile voice services, and other employees can be granted more limited sponsored mobile voice services.

[0051] In some embodiments, the enterprise network administrator uses the enterprise service design center to create an enterprise sponsored service device group list that includes device credentials or device application credentials that the carrier network and/or the enterprise network can use to identify a device or an application on a device as belonging to the group of devices for which the enterprise desires to sponsor enterprise service activities. In some embodiments, an sponsored service activity policy set is created by an enterprise network administrator with an enterprise service design center UI, and an enterprise sponsored service device group list is created by an enterprise network administrator with an enterprise service design center UI, and the two lists are stored in the enterprise service design center in which they are associated with one another for the purpose of provisioning the carrier network, the enterprise network, and/or the devices to provide the desired enterprise sponsored services policy set to the enterprise sponsored services device group, as described herein with respect to various embodiments.

[0052] In some embodiments, the association between an enterprise sponsored services device group and an enterprise sponsored service policy set is used by a service design center to create a provisioning table, in which the provisioning table is a list of the provisioning programming required for the various carrier network elements, enterprise network elements, and/or device elements to implement the desired sponsored service activity policy set for the enterprise sponsored services device group.

[0053] For example, an enterprise can use the service design center to configure certain destinations/services as enterprise services or potentially enterprise services based on various factors (e.g., corporate sites, corporate email/email servers, corporate web pages/intranet, and can, for example, agree to pay for a certain level of general web browsing by usage/time of day and/or other factors, corporate contacts/calendars, corporate videoconferencing; and certain applications, such as web conferencing applications or other applications; certain telephone service usages, etc.). As another example, the service design center can also present a configuration interface that allows users to select from one or more service plans that includes various consumer and enterprise allocations and/or to select an enterprise only service plan.

[0054] In some embodiments, enterprise data locally stored on the wireless communication device is secured and access to an enterprise network from the wireless communication device is secured so that only authorized devices or applications can access the network. In some embodiments, security for enterprise data and network access is accomplished by connecting to the enterprise network via a secure mobile services application on the wireless communication device that connects via a secure channel to a secure mobile services gateway server in the enterprise network. In some embodiments, the SDC is programmed to provision the network and/or device apparatus to detect service usage communication with the mobile services gateway server and record that as a usage charge for network services. In some embodiments, such service usage communication with the mobile services gateway server is credited to the user carrier account or used as a reimbursement to the user bill.

[0055] In some embodiments, determining the enterprise and consumer billing allocation for wireless communication device service usage activities is performed using a classifier implemented on the wireless communication device that classifies the monitored service usage activity (e.g., service usage can also be measured by the classifier and/or another function implemented on the wireless communication device, which can similarly be implemented in a secure execution area or in a secure memory), in which the classifier is executed in a secure execution area or a secure memory of the wireless communication device (e.g., and can also be periodically verified using various techniques, such as by comparing a local service usage measure with a network based service usage measure and/or comparing a secured local service usage measure with another local service usage measure). In some embodiments, a secured

application protects one or more enterprise applications (e.g., email, calendar, contacts, intranet access, and/or other enterprise specified applications, such as applications configured as approved or authorized enterprise applications for a particular enterprise by an enterprise manager using a service design center) from unauthorized use or tampering.

[0056] In some embodiments, the secure mobile services application also provides for usage monitoring of the enterprise service usage of the device. In some embodiments, the secure mobile services application also provides for service access control for the enterprise services of the device so that enterprise network access policies can be locally enforced on the device.

[0057] In some embodiments, security for enterprise data and network access is provided by connecting to the enterprise network via a secure mobile services application executed securely (e.g., in a virtual machine or in a hardware secured execution partition) on the wireless communications device that connects via a secure channel to a secure mobile services gateway server in the enterprise network. In some embodiments, security for enterprise data and network access is provided by connecting to the enterprise network via a secure mobile services application executed on a wireless communications device that includes a service processor, as described herein, that connects via a secure channel to a secure mobile services gateway server in the enterprise network. In some embodiments, the SDC is programmed to provision the network and/or wireless communications device apparatus to detect service usage communication with the mobile services gateway server, and record that as a usage charge for network services. In some embodiments, such service usage communication with the mobile services gateway server is credited to the user carrier account or used as a reimbursement to the user bill.

[0058] In some embodiments, the service processor also provides for service usage monitoring of the enterprise service usage of the device, as described herein with respect to various embodiments. In some embodiments, the service processor also provides for service access control for the enterprise services of the device so that enterprise network access policies can be enforced on the device, as described herein with respect to various embodiments.

[0059] In some embodiments, enterprise and consumer billing allocation for wireless communication device service usage activities includes associating the wireless communication device and/or an authorized user of the wireless communication device (e.g., using device/user

credentials) with an enterprise account (e.g., and a consumer account), associating an application with a service, and associating the service with the enterprise account (e.g., a service for the wireless communication device that the enterprise agreed to pay for). In some embodiments, enterprise and consumer billing allocation for wireless communication device service usage activities further includes using application based monitoring and/or control using, for example, device assisted services.

[0060] In some embodiments, enterprise and consumer billing allocation for wireless communication device service usage activities includes crediting an associated consumer account for service usage allocated to an enterprise account. In some embodiments, enterprise and consumer billing allocation for wireless communication device service usage activities includes billing the enterprise for service usage allocated to the enterprise account. In some embodiments, enterprise and consumer billing allocation for wireless communication device service usage activities includes reporting to the enterprise (e.g., and the consumer) service usage allocated to the enterprise account, and the enterprise can, for example, provide an expense reimbursement to the consumer (e.g., employee, partner, associate, or contractor of the enterprise).

[0061] In some embodiments, enterprise and consumer billing allocation for wireless communication device service usage activities includes associating the wireless communication device with an enterprise account and a consumer account, associating an application with a service, and associating the service with the consumer account (e.g., a service for the wireless communication device that the consumer, such as an employee of the enterprise, agreed to personally pay for). In some embodiments, enterprise and consumer billing allocation for wireless communication device service usage activities further includes using application based monitoring and/or control using, for example, device assisted services.

[0062] In some embodiments, enterprise and consumer billing allocation for wireless communication device service usage activities includes crediting an associated enterprise account for service usage allocated to a consumer account. In some embodiments, enterprise and consumer billing allocation for wireless communication device service usage activities includes billing the consumer for service usage allocated to the consumer account. In some embodiments,

enterprise and consumer billing allocation for wireless communication device service usage activities includes reporting to the enterprise (e.g., and the consumer) service usage allocated to the consumer account, and the enterprise can, for example, deduct the cost for such service usage as an expense from the consumer's periodic/next paycheck.

In some embodiments, enterprise and consumer billing allocation for wireless communication device service usage activities does not require a network element or a device element to control services. For example, a user with a device associated with a bulk service usage plan can be automatically credited for sponsored enterprise service usage. If the bulk service usage plan has a service plan cap associated with the user's consumer service plan, then the service usage classified as sponsored enterprise service usage can be deducted from the total service usage such that the sponsored enterprise service usage does not count towards the user's capped consumer service plan usage. As another example, an enterprise account associated with the wireless communication device and/or user can allow the user to exceed a monthly or other service plan cap for sponsored enterprise service usage (e.g., based on various criteria and/or other factors, such as a more restrictive enterprise service policy to avoid potential misuse of sponsored enterprise services for personal use).

[0063] In some embodiments, enterprise and consumer billing allocation for wireless communication device service usage activities is provided using network based and/or device based techniques as described herein with respect to various embodiments. For example, using various techniques described herein, an enterprise manager can control the services for wireless communication devices for the enterprise, including access to such services and/or charging for such services (e.g., services used by employees in which some are charged to the enterprise on behalf of the employee and some are charged to the employee as a consumer of such services) and user notification messages. For example, the enterprise manager or another network element/function can cap and/or control service usage for consumer services and/or enterprise services.

[0064] In some embodiments, a service usage reconciliation function is provided. In some embodiments, the service usage reconciliation function implements the rules for a billing split for the enterprise and consumer billing allocation for wireless communication device

service usage activities, as described herein with respect to various embodiments. In some embodiments, the service usage reconciliation function also facilitates fraud detection, as described herein with respect to various embodiments.

Carrier Managed Billing Allocation With Service Usage Monitoring In Carrier Network

[0065] **Figure 1** illustrates a functional diagram of a network architecture 100 for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments. In some embodiments, a wireless communication device 110 includes a memory, an application processor (e.g., or more than one application processor or general processor), and a wireless modem, shown as an access modem 151. As shown, the wireless communication device 110 includes an operating system application space 131 for executing applications and communicating wirelessly using operating system lower layers 130, network stack 136, and the access modem 151. As used herein, application space refers to a portion of memory and a portion of a processor operating system execution environment for executing application programs. As also shown, the wireless communications device 110 includes operating system lower layers 130. As used herein, operating system lower layers refers to one or more OS layers that typically implement networking functions (e.g., network stack 136). In some embodiments, operating system lower layers 130 is where certain application data and communications security functions are implemented as described herein. In some embodiments, operating system lower layers 130 is where certain service usage monitoring and reporting functions are implemented as described herein. In some embodiments, the operating system application space 131 executes various user applications, including user data applications 111 and user voice applications 112, and various enterprise applications, including enterprise data applications 124 and enterprise voice applications 126. In the embodiments, the execution environment for user applications and enterprise applications is the same (e.g., as shown in Figures 1 through 7). For example, a consumer Internet browser can execute in the operating system application space 131 for providing Internet web site browsing or web based email service via network stack 136 and wireless access modem 151 (e.g., a wireless modem), and an enterprise email program can also execute in the operating system application space 131 to communicate with an enterprise email server also via network stack 136 and wireless access modem 151. In some embodiments, the

execution environment for user applications and enterprise applications are not the same (e.g., as shown in Figures 8 through 12).

[0066] In some embodiments, device 110 access various voice network based services, such as consumer voice services 167 and/or enterprise sponsored/paid for consumer voice services usage, via voice network 165. As shown, voice network 165 is in communication with the carrier gateway/HA 152 via carrier access network 150. In some embodiments, device 110 access various Internet based services, such as consumer Internet services 162 and/or enterprise sponsored/paid for consumer Internet services usage, via the Internet 160.

[0067] As also shown in Figure 1, the device 110 is in wireless communication (e.g., 2G/3G/4G access) with a carrier access network 150. The carrier provides a carrier usage accounting server 154 (e.g., a carrier billing server) in communication with the carrier access network 150. The carrier network access 150 is shown in communication with both the Internet 160 and an enterprise network 170 via the Internet 160. The enterprise network 170 is shown in communication with the Internet 160 as via an enterprise firewall and secure access gateway 171 for protecting enterprise network 170 from unauthorized access. In some embodiments, to access the enterprise network 170 through enterprise firewall and secure access gateway 171, the device 110 includes a secure data application or a virtual private network application/function to facilitate secure authorization with the enterprise firewall and secure access gateway 171 and to also protect the communication (e.g., encrypt such data communications). As also shown, behind enterprise firewall and secure access gateway 171, the enterprise network 170 provides communication with an enterprise mobile services gateway/server 172 in communication with the enterprise network 170. As shown, enterprise mobile services gateway server 172 includes various enterprise applications/function, including as shown, mobile email 173, mobile synchronization 174, mobile contacts 175, mobile calendar 176, mobile communications 177, and mobile intranet 178. In some embodiments, the enterprise mobile services gateway server 172 provides mobile device mobile access to various enterprise network intranet services via enterprise intranet servers 180. In some embodiments, the enterprise mobile services include email, contacts, calendar, enterprise communications, mobile device synchronization services, intranet internal web sites, internal enterprise applications, enterprise file systems, and/or other enterprise networking services. In some embodiments, the enterprise mobile services gateway

server 172 provides optimized mobile application formatting of the enterprise information or synchronization services to synchronize the enterprise database for the above services in an efficient and/or timely manner.

[0068] In some embodiments, the carrier usage accounting server 154 (e.g., the carrier billing server) communicates (e.g., using secure communication techniques) with a service usage reconciliation server function 158 to obtain reconciled service charging reports (e.g., reconciled billing reports) and/or enterprise service usage charging credit reports. In some embodiments, the reconciled service charging reports (e.g., reconciled billing reports) and/or enterprise service usage charging credit reports are processed by the carrier usage accounting server 154 and reported as user usage record(s) 155 and/or enterprise usage record(s) 156. For example, mediating such charging and credit reports can be based on various factors as described herein (e.g., by application, time of day/day of week, and/or other factors). For example, the service usage charges that occur due to communication with the servers or services that are part of the enterprise network 180, including the enterprise mobile services gateway server 172 and intranet servers 180, can be counted as an enterprise service usage credit. In some embodiments, the enterprise service design center 194 issues device provisioning instructions for the device credential list from the enterprise services device group, and for each of the credentials, a service control policy is set on the enterprise firewall/secure gateway 171 to allow properly authorized devices to reach the desired destinations listed on the enterprise service activity policy set. The provisioning of the enterprise firewall/secure gateway 171 with the enterprise service device group credentials and the enterprise service policy set is illustrated in Figure 1 by the “C” input designator.

[0069] In some embodiments, an enterprise service design center UI 196 and service design center 194 are provided as shown in Figure 1. In some embodiments, the enterprise service design center UI 196 and service design center 194 provide dedicated enterprise control of the network policy provisioning for configuring the service charging, accounting or billing allocation policies for differentiating between enterprise device service usage activities and consumer device service usage activities. Furthermore, in some embodiments, the portion of the enterprise network policy provisioning information that is needed to provision the carrier network elements to implement various techniques for allocating device service usage between

enterprise and consumer activities is communicated between the enterprise service design center 194 and a carrier service design center 190.

[0070] A carrier provisioning system is typically not capable of providing direct access to an enterprise network administrator (e.g., carrier or enterprise personnel) for the purpose of provisioning such service charging capabilities. For example, such direct access is often not provided due to concerns related to the risk to the entire network that exists if network provisioning controls are made available to many different administrators to program charging allocation policies for many enterprises. However, as described herein, by isolating the required carrier network provisioning information to a secure service design center UI and policy configuration that only influences a small portion of the carrier network policy provisioning available to the carrier service design center and UI, the risk of causing such problems with the carrier network configuration is significantly reduced. Additionally, the process of performing the carrier side of the necessary provisioning is simplified for an administrator or in some cases can be automated.

[0071] The service design centers are shown in Figure 1 and various other figures as separate network elements in order to more clearly define and discuss the functions of the service design centers. In some embodiments, the enterprise service design center 194 is implemented in various other network elements (e.g., in enterprise network management apparatus, such as management functions of the secure enterprise mobile services gateway server 172 or other enterprise network management apparatus). In some embodiments, the enterprise service design center 194 is implemented as a securely partitioned and managed device group interface to a subset of the provisioning capabilities of a carrier network service design center 190. In some embodiments, the enterprise service design center 194 is implemented as a securely partitioned and managed device group interface to a subset of the provisioning capabilities of a cloud based secure enterprise mobile services network that is run by a centralized enterprise services provider such as an ASP or MVNO. As will be apparent to one of ordinary skill in the art in view of the various embodiments described herein, the enterprise service design center 194 can be implemented using various network and software/hardware architectures while providing for secure and controlled access as described herein.

[0072] In some embodiments, the enterprise service design center administrator creates or imports the enterprise service device group credentials and the enterprise service policy set using enterprise service design center UI 196. In some embodiments, the information included in the enterprise service device group credentials and the enterprise service policy set is also communicated from the enterprise service design center 194 to the carrier service design center 190 via the “C” connection designator as shown. For each of the device credentials listed in the enterprise services device group, the carrier service design center 190 determines the information it needs to properly provision for the carrier gateway/home agent 152 with the proper access policy allowances and service usage charging policies to provide enterprise service access and usage credit for communications from the device 110 to the enterprise network destination addresses specified in the enterprise service policy set. Programming of this provisioning information to the carrier gateway/home agent 152 is indicated by the “A” information connector from the carrier service design center 190 to the carrier gateway/home agent 152. In some embodiments, this provisioning (e.g., programming) information sent via provisioning communication link “A” to the carrier gateway/home agent 152 includes programming the enterprise device group credentials to: (i) receive the desired access service policy permissions, and (ii) implement the desired service usage accounting/charging policy settings. From the enterprise device group credentials list and the enterprise service activity policy set information provided in “C”, the carrier service design center 190 determines the information needed to properly provision the service usage reconciliation server function 158. Programming of this provisioning information to the service usage reconciliation server function 158 is indicated by the “B” information connector from the carrier service design center 190 to the service usage reconciliation server function 158. In some embodiments, the service usage reconciliation server function 158 is part of the carrier network, and the service usage reconciliation server function 158 implements the charging reconciliation rules to determine how much of the recorded device 110 service usage to place on the user’s usage record or service bill (e.g., consumer service usage cost allocation) and how much to place on the enterprise’s usage record or service bill (e.g., enterprise service usage cost allocation).

[0073] The various embodiments described herein with respect to Figure 1 support a variety of techniques for allocating service usage accounting or billing between enterprise services and consumer services. For example, the service usage reconciliation server function

158 can report measured total usage, measured consumer usage, and/or measured enterprise usage to the carrier usage accounting server 154. In some embodiments, the reconciliation service usage function (e.g., provide by the service usage reconciliation 158 and/or another element/function) implements the business rules that determine how much of the service usage to charge the user (e.g., a consumer service usage allocation) and how much of the service usage to charge the enterprise (e.g., an enterprise service usage allocation). In some embodiments, the service usage reconciliation service usage function records total device service usage, records total enterprise service activity service usage, and then subtracts the enterprise service usage from the total device service usage to determine a consumer service usage (e.g., a consumer service usage allocation). In some embodiments, the service usage reconciliation server function 158 passes on the enterprise service usage as a credit to the consumer account. In some embodiments, this credit is accounted for by the carrier billing the user at a reduced amount according to the credit and billing the enterprise for an increased amount according to the credit. In some embodiments, the credit is accounted for by communicating the credit to the enterprise so the enterprise can reimburse the consumer (e.g., generating an expense reimbursement for the credit to the consumer as an employee or contractor of the enterprise, directly paying the enterprise allocation of the carrier bill for the consumer, and/or various other approaches as described herein). In some embodiments, the credit is reported to the enterprise so that the enterprise can seek payment for the non-enterprise service usage (e.g., consumer service usage allocation) from the consumer (e.g., who can be an employee or contractor of the enterprise).

[0074] As another example, an enterprise allocation can also include providing an allowance for a certain level of monthly usage of data and/or voice. In some embodiments, the carrier usage accounting server 154 generates a bill for the associated consumer account (e.g., associated with the device 110, such as based on the device/user credentials) that reflects the cost of the service usage allocated to consumer service usage and a credit for the cost of service usage allocated to enterprise service usage (e.g., to offset the cost of the enterprise service usage, which can be billed to the enterprise account associated with the enterprise service usage for the device 110). As described herein, based on an allocation of enterprise and consumer service usage, various techniques for billing/charging and generating credits/reporting (e.g., the enterprise can generate the user/employee monthly expense reimbursements to compensate the user/employee for the determined cost of the enterprise service usage and/or other approaches as described

herein) can be provided using the network architecture 100 and/or other network architectures, as described herein.

[0075] In some embodiments, the enterprise mobile services gateway server 172 is a dedicated enterprise application server for a particular enterprise (e.g., company, government organization, school/university, or another entity). In some embodiments, the enterprise mobile services gateway server 172 is a carrier or a third party service provider (e.g., a carrier for wireless network services, such as AT&T, Sprint, T-Mobile, and/or various other wireless network service providers/carriers or third party service providers) controlled/managed application server that performs the application server functions for various different enterprises (e.g., as a service/outsourced IT services model). In some embodiments, the device 110 is partitioned (e.g., associated with a particular enterprise/MVNO partition and associated enterprise account) based on device credentials and/or VPN to determine a service plan for managing (e.g., to determine how to allocate enterprise/consumer service usage for) the device 110. In some embodiments, based on the partition determination of the device 110, and the associated service plan for managing the device 110, appropriate service usage monitoring and classification can be determined for providing an enterprise and consumer allocation for service usage activities of the device 110 based on the associated service plan(s).

[0076] For example, by programming the business rules in service usage reconciliation server 158 that determine the service usage accounting allocation between enterprise services and consumer services, many approaches can be provided for creating a service that provides an enterprise service to a device when the device user has selected a consumer service plan or elected to pay for a consumer service plan. As an example, if the device user has chosen a service plan, the enterprise service usage accounted for in enterprise usage record 156 can be billed to the enterprise rather than the consumer. As another example, if the device user has chosen a service plan, the consumer service usage accounted for in user usage record 155 can be billed to the device user rather than the enterprise. As yet another example, if the device user has selected a service plan, the enterprise service usage can be communicated to the enterprise (e.g., and/or the device user), and the enterprise can issue a reimbursement to the device user for the enterprise portion of the user's bill, or pay the carrier directly for a portion of the user's bill thus reducing the amount the user must pay. In some embodiments, the business rules in service

usage reconciliation server 158 are programmed to provide the device user with a certain amount of service usage that may or may not be directly related to enterprise services.

[0077] For example, the user can be allocated a certain amount of general purpose browsing that includes network destinations that are not specified in the enterprise service activity policy set. In some embodiments, there is a cap to such general purpose browsing, and the carrier service design center 190 can provision the network and/or the device to alert the user regarding how much of the enterprise sponsored browsing remains or when the enterprise sponsored internet browsing cap is reached or exceeded. In some embodiments, the business rules in service usage reconciliation server 158 are programmed to deduct the service usage associated with the enterprise sponsored general purpose browsing, up to the specified cap, from the user's bill. In this way, the user can be allocated an allowance for services that either the enterprise sponsors to account for enterprise related service usage that may not be included in the enterprise service activity policy set or that the enterprise simply desires to sponsor to reduce the device user's consumer service plan billing.

[0078] In a similar manner, services other than browsing that are not necessarily associated with enterprise service usage can also be sponsored by the enterprise by properly provisioning the business rules in service usage reconciliation server 158. For example, a catch-all enterprise sponsored allowance (e.g., or cap) for "bulk" internet usage can be provided. The fact that the user is provided with such an allowance may be pointed out to the user if the user disputes how much of their device service usage cost should be covered by the enterprise and how much they should cover personally. Another example is to provide a certain amount of voice minutes to any phone number or to phone numbers not in the enterprise service activity policy set.

[0079] In some embodiments, the business rules in service usage reconciliation server 158 are provisioned so that the enterprise specifically does not sponsor or pay for certain device service usage activities. In some embodiments, these service usage activities can include access to network destinations, applications, or services that pose security risks to enterprise data stored on device 110 or pose security risks to enterprise network 170. In some embodiments, these activities include access to network destinations, applications, or services that the enterprise does

not wish to sponsor or that are potentially associated with user activity that violates enterprise policy or laws. In some embodiments, such service usage activities that violate enterprise security policies or other service usage policies are blocked by the business rules programmed into the network or the device as specified in the enterprise service activity policy set.

[0080] By programming the business rules in service usage reconciliation server 158 that determine the service usage accounting allocation between enterprise services and consumer services, many approaches can be provided for creating a service that provides an enterprise service to a device when the device user has not selected a consumer service plan or elected to pay for a consumer service plan. For example, if the device user has not chosen to select or pay for a consumer service plan, the carrier gateway/home agent 152 can be programmed to allow service usage for the enterprise service policy set but deny all other access until the user chooses a consumer service plan. In some embodiments, when/if the consumer chooses a consumer service plan then access would be expanded beyond just the enterprise services, because when the service plan activation occurs the carrier gateway/home agent 152 consumer services policy set will be updated allowing service (e.g., as the carrier administrator user of the carrier service design center 190 programs a different set of consumer service access policies for each consumer service plan that can be chosen). In some embodiments, the user is allocated a certain amount of general purpose data access or voice minutes as described above even though the user does not have a consumer data plan. Another example is to provide the user with a certain monetary allowance that is sponsored by the enterprise rather than a service usage amount.

[0081] Although the enterprise service design center 194 is shown provisioning the mobile server usage counter 179 (e.g., shown in Figure 5) and the enterprise firewall/secure gateway 171, it should be understood that not all device provisioning connections as shown from the enterprise mobile services server 172 to the device 110 are shown for device functions including secure mobile services application access, communication link provisioning (e.g., cryptographic encryption keys, VPN settings, and various other security/communication provisioning), security programs, service control programs, and program settings for enterprise service applications, such as email, calendar, contacts, mobile synchronization services, and traffic control. As shown, the labeled provisioning connections are provided as exemplary embodiments to assist in identifying the network elements that are provisioned for network

access control and network service usage charging reporting. Those of ordinary skill in the art will appreciate that these additional device provisioning functions are not necessarily specifically called out with provisioning connection labels in each figure, and it will be apparent to one of ordinary skill in the art which of these device provisioning functions and connections are needed from the enterprise service design center 194 and the device 110. It will also be apparent to one of ordinary skill in the art in view of the various embodiments described herein that the various device provisioning connections and device element programming configurations needed to provision these device functions can be managed by the secure enterprise mobile services gateway server 172 via a device management communications link. It will also be apparent to one of ordinary skill in the art that, in some embodiments, the flow of policy provisioning information for the various device elements that participate in establishing service usage monitoring and reporting policies or service access control policies starts in the enterprise service design center 194 and flows through the secure enterprise mobile services gateway/server 172 over a device management link, and through the device management link on device 110 to the device 110 functional elements that need to be provisioned. In various embodiments described herein, the device elements that are provisioned in some embodiments to set up enterprise services, service usage monitoring and reporting policies, or service usage access control policies include one or more of enterprise applications 124 and 126, secure mobile enterprise application environment 120, secure network interface 128, secure enterprise mobile services application 125, virtual machine #2 secure enterprise application environment 118, enterprise application secured hardware execution partition 106, device service usage counter 119, service processor framework program 139, and/or service processor kernel program 138.

[0082] In some embodiments, the service usage reconciliation server 158, or the secure enterprise mobile services gateway 172, or another similar network function, is programmed to review traffic usage patterns of mobile device 110 for the purpose of determining if the device may have fallen into unauthorized hands or if the device secure enterprise communications and data management software may have been hacked or tampered with in a way that endangers enterprise security or causes the enterprise to be billed for usage that is not enterprise usage. For example, the service usage reconciliation server 158 (e.g., or the secure enterprise mobile services gateway 172) can be programmed to monitor “bulk” enterprise service usage for the enterprise device group and trigger a fraud detection alert for a device that exhibits enterprise

usage that is higher than a pre-determined “normal” limit. As another example, the service usage reconciliation server 158 can be programmed to monitor “bulk” enterprise service usage for the enterprise device group and trigger a fraud detection alert for a device that exhibits enterprise usage access patterns that are determined to be outside of “normal” limits. Examples of usage patterns can include usage as a function of time of day, duration of usage, usage above a certain limit for a subset of service usage activities, and/or usage above a certain limit for all service usage activities.

Carrier Managed Billing Allocation With Service Usage Monitoring In Carrier Network and Enterprise Firewall/Gateway

[0083] **Figure 2** illustrates a functional diagram of another network architecture 101 for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments. The network architecture 101 of Figure 2 is similar to the network architecture 100 of Figure 1, except that in the network architecture 101 of Figure 2 the service usage reconciliation 158 receives service usage information from the enterprise firewall/secure gateway 171 in addition to the carrier gateway/home agent 152. This allows for various techniques that augment the capabilities of the carrier gateway/home agent 152. For example, in networks in which it is impractical or infeasible for the carrier gateway/home agent 152 to keep track of the service usage accounting allocation between the enterprise service policy set and consumer services for the devices in the device group, the service usage reconciliation 158 can receive total device service usage from carrier gateway/home agent 152, and receive the enterprise service usage from enterprise firewall/secure gateway 171. With this information the service usage reconciliation service usage function can perform the allocation between enterprise service usage and consumer service usage without any detailed service usage reports from carrier gateway/home agent 152.

[0084] There are several reasons that the carrier network may not support numerous enterprise service customers with an enterprise/consumer allocation architecture that requires the carrier gateway/home agent 152 to perform the necessary traffic classification or service usage classification as in the Figure 1 embodiment. For example, these reasons can include: (i) the carrier gateway/home agent does not have the detailed service usage classification capability

(e.g., deep packet inspection function(s)) required to allocate service usage between the enterprise service policy set and consumer services for the devices in the device group, (ii) the carrier gateway/home agent 152 is capable of performing the service monitoring required but can only do it for a limited number of devices (e.g., scaling issues), and/or (iii) there are too many device groups being managed by enterprise partners of the carrier creating a situation where the number of specialized profiles that must be supported by the carrier gateway/home agent 152 is larger than can be accommodated by the profile management capacity of the gateway system (e.g., scaling issues). As would now be apparent to those of ordinary skill in the art in view of the embodiments described herein, there are other reasons that can make it advantageous to provide the enterprise service usage from the enterprise network.

[0085] In some embodiments, provisioning with the service design centers and UIs for the embodiment shown in Figure 2 is similar to that of Figure 1. In some embodiments, the billing allocation capabilities of the two embodiments are similar if the carrier gateway/home agent 152 is fully capable to differentiate service usage between the enterprise service policy set and the consumer services, but if not, then as discussed above, the billing allocation capabilities of the Figure 2 embodiment can be preferable in such environments.

[0086] Because the enterprise service usage is monitored by the enterprise network elements in the embodiments depicted in Figure 2, various service accounting or billing policies are available to the enterprise or carrier. For example, the amount of service usage resulting from enterprise services that occur during roaming conditions can be accounted for even when the carrier network does not receive detailed classification of service usage from roaming network partners. The business rules programmed into the service usage reconciliation server 158 that are determined by the enterprise service activity policy set can break-out enterprise service related roaming charges separate from consumer service related roaming charges so that these are sponsored or paid by the enterprise while consumer roaming service usage activities are not or are only subsidized but not completely paid. In addition, in some embodiments, the secure enterprise mobile services gateway 172 includes the capability to determine if the device is roaming so that the access control policies specified in the enterprise service activity policy set can include modification or denial of access to enterprise network 170 services allowed by the

enterprise firewall/secure gateway 171 or the secure enterprise mobile services gateway 172 during roaming conditions even though the access is not controlled by the carrier home network.

[0087] In some embodiments, an active network detection function is included on the device to assist the network policy enforcement elements to determine the type of network the device is connected to or to determine if the device is on a home or roaming network, as described herein. For example, the service usage policy allowances provided by the enterprise service activity policy set can be programmed so that the allowances change depending on the availability of a particular network or set of networks, the time of day, the congestion state of a network, or the current cost of service on the network. For example, if the carrier home network is not available and only a roaming network is available, the allowance may be decreased or removed. As another example, if a certain network type is not available but another network type is (e.g., 2G is available instead of 3G or 3G is available instead of 4G), then the allocation can be reduced. As yet another example, if a variable charging policy is in place with the carrier for access when the network is busy or during certain times of day, then the enterprise sponsored allowance can be reduced during times of higher charging.

Enterprise Managed Billing Allocation With Service Usage Monitoring in Carrier Network And Enterprise Firewall/Gateway

[0088] **Figure 3** illustrates a functional diagram of another network architecture 102 for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments. The network architecture 102 of Figure 3 is similar to the network architecture 101 of Figure 2, except that in the network architecture 102 of Figure 3 the service usage reconciliation server function 158 receives overall device service usage information from the carrier usage accounting server 154 and also receives enterprise device service usage information from enterprise firewall/secure gateway 171. In some embodiments, there is no interaction between the provisioning of the carrier network and the provisioning of the enterprise network, and it is assumed that the service usage reconciliation function 158 and the enterprise usage accounting server 159 are both under the control of the enterprise administrator. This approach allows for various techniques that provide for enterprise allocation of consumer service usage and enterprise service usage without the need to interface to

the carrier network other than to get the overall usage summary. For example, the service usage reconciliation server 158 can receive total or “bulk” usage from carrier usage accounting server 154, receive enterprise service usage from enterprise firewall/secure gateway 171, and determine the amount of consumer service usage, enterprise service usage, and/or an enterprise service usage credit.

[0089] In some embodiments, provisioning with the service design centers and UIs for the embodiment shown in Figure 3 is similar to that of Figure 1 except that no provisioning of enterprise service parameters is required in the carrier network. The billing allocation capabilities are also similar if the carrier gateway/home agent 152 is fully capable to differentiate service usage between the enterprise service policy set and the consumer services, but if not, then as discussed above, the billing allocation capabilities of the Figure 3 embodiment can be preferable in such environments. For example, using the network architecture 102, the enterprise can deal directly with their employees without the need to bring the carrier into the consumer versus enterprise allocation process. As an example, the carrier could have a policy in which consumers purchase their own mobile device services and then get credit for enterprise mobile device services at the end of each billing period. This credit can be provided back to the employee in the form of an expense reimbursement or an increase in their next paycheck.

Enterprise Usage Credit With Service Usage Monitoring in Enterprise Firewall/Gateway

[0090] **Figure 4** illustrates a functional diagram of another network architecture 103 for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments. The network architecture 103 of Figure 4 is similar to the network architecture 102 of Figure 3, except that in the network architecture 103 of Figure 4 the service usage reconciliation server function 158 receives no overall device service usage information from the carrier network. As shown in Figure 4, the source of service usage information is the enterprise network (e.g., specifically the enterprise firewall/secure gateway 171). In some embodiments, there is no interaction between the provisioning of the carrier network and the provisioning of the enterprise network, and it is assumed that the service usage reconciliation function 158 and the enterprise usage accounting server 159 could both be under the control of the enterprise administrator. For example, the network architecture 103 of

Figure 4 can be less dependent on the carrier than the network architecture 102 of Figure 3 in that no billing information feed is provided. Using various techniques described herein, an enterprise service usage credit can be determined, and the determined enterprise service usage credit can be reimbursed to the device user.

Carrier Managed Billing Allocation With Service Usage Monitoring In Carrier Gateway/Home Agent And Enterprise Mobile Services Gateway Server

[0091] **Figure 5** illustrates a functional diagram of another network architecture 200 for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments. The network architecture 200 of Figure 5 is similar to the network architecture 101 of Figure 2, except that in the network architecture 200 of Figure 5 the enterprise mobile services gateway server 172 includes a mobile server usage counter 179, and the enterprise service usage reports from this function are sent to the service usage reconciliation 158 instead of usage reports being sent from the enterprise firewall/secure gateway 171. In some embodiments, various specialized needs of monitoring, recording, and reporting enterprise service usage are confined to the special purpose enterprise mobile services gateway/server 172 rather than requiring the often more general purpose enterprise firewall/secure gateway 171 to perform these functions.

Enterprise Managed Billing Allocation With Service Usage Monitoring in Carrier Network And Enterprise Mobile Services Gateway Server

[0092] **Figure 6** illustrates a functional diagram of another network architecture 201 for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments. The network architecture 201 of Figure 6 is similar to the network architecture 102 of Figure 3, except that in the network architecture 201 of Figure 6 the enterprise mobile services gateway server 172 includes a mobile server usage counter 179, and the enterprise service usage reports from this function are sent to the service usage reconciliation server 158 instead of usage reports being sent from enterprise firewall/secure gateway 171. For example, this approach allows for the specialized needs of monitoring, recording, and reporting enterprise service usage to be performed by the special

purpose enterprise mobile services gateway/server 172 rather than requiring the often more general purpose enterprise firewall/secure gateway 171 to perform such functions.

Enterprise Usage Credit With Service Usage Monitoring in Enterprise Mobile Services Gateway Server

[0093] **Figure 7** illustrates a functional diagram of another network architecture 202 for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments. The network architecture 202 of Figure 7 is similar to the network architecture 103 of Figure 4, except that in the network architecture 202 of Figure 7 the enterprise mobile services gateway server 172 includes a mobile server usage counter 179, and the enterprise service usage reports from this function are sent to the service usage reconciliation server 158 instead of usage reports being sent from enterprise firewall/secure gateway 171. For example, this approach allows for the specialized needs of monitoring, recording and reporting enterprise service usage to be performed by the special purpose enterprise mobile services gateway/server 172 rather than requiring the often more general purpose enterprise firewall/secure gateway 171 to perform such functions.

Carrier Managed Billing Allocation With Device Mobile Enterprise Services Application Environment and Service Usage Monitoring In Carrier Network

[0094] **Figure 8** illustrates a functional diagram of another network architecture 300 for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments. As shown, a secure mobile enterprise application environment 120 and a secure network interface 128 within the secure mobile enterprise application environment 120 are included in the device 110. Also, a server secure network interface 127 is included in the secure enterprise mobile services gateway/server 172. In some embodiments, the secure mobile enterprise application environment 120 protects sensitive enterprise information that is stored on the device (e.g., email text and downloads, calendar information, contacts, intranet data, and any other enterprise data) and provides a secure communication channel function to allow for authentication with the server secure network interface 127 on the secure enterprise mobile services gateway/server 172. As also

shown, a user services application environment in the device 110 includes various user applications, such as a user data application 111 and a user voice application 112.

[0095] In some embodiments, provisioning of the various network architecture elements to facilitate the allocation between enterprise service usage accounting or billing and consumer service usage accounting or billing is established as follows. The device portion of secure network interface 128 and the enterprise server portion of server secure network interface 127 are provisioned with connection “E”. In some embodiments, this provisioning operation with the connection labeled “E” includes programming information for the secure network interface 128 to direct the enterprise network 170 access traffic associated with application functions running in secure mobile enterprise application environment 120 to enterprise network 170 destinations that are to be sponsored (e.g., and possibly intermediate network routes) according to the enterprise services policy set, including, for example, the addresses (e.g., IP, IP/port or other higher layer address identifiers) of secure enterprise mobile services gateway/server 172 or enterprise intranet servers 180. In some embodiments, the provisioning operation designated with the connection label “E” also establishes the parameters required for the secure communication of information between the secure network interface 128 and the server secure network interface 127. In some embodiments, this provisioning step sets up the policies for the authentication process, data encryption, and cryptographic key exchange processes take place to establish secure communication between the secure mobile enterprise application environment 120 and secure enterprise services gateway/server 172.

[0096] In some embodiments, the enterprise network destinations that are to be sponsored according to the enterprise services policy set identified by provisioning connection “E” are also communicated to the carrier service design center 190. For example, this allows the carrier service design center 190 to determine and transmit the proper provisioning information to establish the access control policies or service usage accounting policies for these aspects of the enterprise services policy set. Carrier service design center provisioning connections “A” communicates the provisioning information (programming) to carrier gateway/home agent 152. Carrier service design center provisioning connections “B” communicates the provisioning information (programming) to service usage reconciliation server 158.

[0097] In some embodiments, the provisioning operation associated with the provisioning connection label “C” provisions the enterprise firewall/secure gateway 171 to admit devices 110 with device credentials or application credentials that belong to the desired enterprise services device group associated with the enterprise service policy set. In some embodiments, the provisioning information labeled as “C” includes the enterprise network 170 destinations that are to be sponsored (e.g., and possibly intermediate network routes) according to the enterprise services policy set. In some embodiments, the provisioning information labeled as “C” includes only the network destinations for the secure enterprise mobile services gateway/server 172 and devices 110 are not allowed access to other parts of the enterprise network 170.

[0098] In some embodiments, the network architecture 300 for providing enterprise and consumer billing allocation for wireless communication device service usage activities includes executing enterprise applications as secure applications 124 in the secure area 120 of the device 110 in which the secure applications are in network communication (e.g., secure network communication, such as via a virtual private network (VPN) or other secure network communication techniques) with the secure application 172 (e.g., executing an enterprise server side of the enterprise authorized/sponsored applications, such as an enterprise email server, an enterprise calendar server, an enterprise contacts server, and/or an enterprise network access server) of the enterprise. In some embodiments, the secure application server 172 performs application monitoring that includes counting application service usage (e.g., bytes used in communicating with the device’s execution of various secure enterprise applications 124). In some embodiments, the secure application server 172 performs application monitoring that further includes classifying application service usage (e.g., classifying various secure enterprise applications 124 by application/service usage activity such as based on application name or using signed code/hash techniques, by time of day/day of week, enterprise server, destinations, enterprise intranet, and/or other factors).

Carrier Managed Billing Allocation With Device Mobile Enterprise Services Application Environment and Mobile Services Gateway Server With Service Usage Monitoring In Carrier Network

[0099] **Figure 9** illustrates a functional diagram of another network architecture 301 for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments. The network architecture 301 of Figure 9 is similar to the network architecture 300 of Figure 8, except that in the network architecture 301 of Figure 9 the secure enterprise mobile services gateway/server 172 is located between the Internet 160 and the enterprise network 170. For example, this approach allows for the server secure network interface 127 of the secure enterprise mobile services gateway/server 172 to restrict access to the enterprise network 170 and enterprise intranet servers 180 based on device authentication and/or various other security techniques (e.g., secure access, authentication, and/or communication techniques) and as would be apparent to one of ordinary skill in the art in view of the various embodiments described herein.

Carrier Managed Billing Allocation With Device Mobile Enterprise Services Application Environment and Mobile Services Gateway Server With Service Usage Monitoring In Carrier Network And Mobile Services Gateway Server

[00100] **Figure 10** illustrates a functional diagram of another network architecture 302 for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments. The network architecture 302 of Figure 10 is similar to the network architecture 301 of Figure 9, except that in the network architecture 302 of Figure 10 the secure enterprise mobile services gateway/server 172 includes a mobile service usage monitor 179 that reports enterprise service usage to the service usage reconciliation 158. In some embodiments, various specialized needs of monitoring, recording, and reporting enterprise service usage are confined to the special purpose enterprise mobile services gateway/server 172 rather than requiring the often more general purpose enterprise firewall/secure gateway 171 and/or other network elements/functions to perform such functions.

Enterprise Managed Billing Allocation With Device Mobile Enterprise Services Application Environment and Mobile Services Gateway Server With Service Usage Monitoring In Mobile Services Gateway Server

[00101] **Figure 11** illustrates a functional diagram of a network architecture 303 for providing enterprise and consumer billing allocation for wireless communication device service

usage activities in accordance with some embodiments. The network architecture 303 of Figure 11 is similar to the network architecture 302 of Figure 10, except that in the network architecture 303 of Figure 11 includes another carrier usage accounting server 154B that reports service usage to the service usage reconciliation 158. In some embodiments, the carrier usage accounting server 154B receives overall or bulk service usage data from the carrier gateway/HA 152 and forward such information to the service usage reconciliation 158. The service usage reconciliation 158 reconciles the overall or bulk service usage received from the carrier accounting server 154B and the enterprise service usage received from the mobile server usage monitor 179 and provides such reconciled service usage information to the carrier usage accounting 154A.

Enterprise Usage Credit With Device Mobile Enterprise Services Application Environment and Mobile Services Gateway Server With Service Usage Monitoring In Mobile Services Gateway Server

[00102] **Figure 12** illustrates a functional diagram of a network architecture 304 for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments. The network architecture 304 of Figure 12 is similar to the network architecture 303 of Figure 11, except that in the network architecture 304 of Figure 12 the only service usage reported to the service usage reconciliation 158 is the enterprise service usage received from the mobile server usage monitor 179. In some embodiments, the service usage reconciliation 158 reconciles the enterprise service usage received from the mobile server usage monitor 179 and provides such reconciled service usage information to the carrier usage accounting 154, which generates the enterprise service usage record(s) 156.

Device Configurations Without Service Usage Monitoring and Reporting

[00103] **Figure 13** illustrates a functional diagram of a secure device application architecture for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments. As shown, device 110 includes an operating system application space 131, an operating system lower layers 130 including a network stack 121, and an access modem (e.g., wireless modem) 129. As also

shown, the operating system application space 131 includes various user applications, such as user data application 111 and user voice application 119, and a service usage monitor 119. The operating system application space 131 also includes a secure enterprise mobile services application 125, which includes various enterprise applications, such as email, synchronization, contacts, calendar communications, and intranet. The secure enterprise mobile services application 125 also includes a secure network interface 128 (e.g., for securely communicating with an enterprise network).

[00104] **Figure 14** illustrates a functional diagram of another secure device virtual machine architecture for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments. Figure 14 is similar to Figure 13, except that in Figure 14 the user applications are executed/stored within the virtual machine (VM) #1 consumer application environment 117 and the secure enterprise mobile services application 125 is included within the virtual machine (VM) #2 secure enterprise application environment 118. The device 110 also includes a virtual machine operating system 115 that includes a virtual OS instantiation #1 117A for the VM #1 consumer application environment 117 and a virtual OS instantiation #2 118A for the VM #2 secure enterprise application environment 118. As also shown, the virtual machine operating system 115 includes a virtual machine OS network stack 116.

[00105] **Figure 15** illustrates a functional diagram of another secure device hardware execution partition architecture for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments. Figure 15 is similar to Figure 14, except that in Figure 15 hardware partitions are provided instead of virtual partitions. As shown, the user applications are executed/stored within a user application secured hardware execution partition 105 and the secure enterprise mobile services application 125 is included within an enterprise application secured hardware execution partition 106. The device 110 also includes a secured hardware partition for OS 115 that includes a secure hardware partition manager #1 107 for the user application secured hardware execution partition 105 and a secure hardware partition manager #2 108 for the enterprise application secured hardware execution partition 106. As also shown, the secured hardware partition for OS 115 includes a an OS network stack 116.

[00106] **Figure 16** illustrates a functional diagram of another secure device service processor architecture for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments. As similarly described herein with respect to various embodiments, the device architecture of Figure 16 includes a service processor framework program 139 (e.g., framework space agent/function) and network stack framework components 137 in an operating system framework space 133, and a service processor kernel program 138 (e.g., kernel space agent/function) and network stack kernel components 135 in an operating system kernel space 132. In some embodiments, the service processor functions provide a user interface function to communicate to a user of the device 110 whether or not a service usage activity is an approved/authorized service usage activity, or whether it is a disallowed service usage activity for the device 110 (e.g., the enterprise has disallowed the usage of the device 110 for such service usage activities, such as online gaming and/or certain other online activities or certain long distance calling or voice usage during certain days, such as weekends) or whether such would/will be charged/billed to the user as a consumer under the user's consumer plan. In some embodiments, the service processor functions provide a user interface function to communicate to a user of the device 110 an associated cost of certain service usage activities allocated to consumer service usage. In some embodiments, the service processor functions provide a user interface function to communicate to a user of the device 110 an associated credit of certain service usage activities allocated to enterprise service usage. In some embodiments, the service processor functions provide a user interface function to communicate to a user of the device 110 various other information as described herein with respect to providing an enterprise and consumer allocation for service usage activities. In some embodiments, the service processor shown in Figure 16 communicates with a service controller, such as described herein with respect to various embodiments.

Carrier Managed Billing Allocation With Device Mobile Enterprise Services Application Environment and Mobile Services Gateway Server With Service Usage Monitoring In Carrier Network And On Device

[00107] **Figure 17** illustrates a functional diagram of another network architecture 400 for providing enterprise and consumer billing allocation for wireless communication device service

usage activities in accordance with some embodiments. The network architecture 400 of Figure 17 is similar to the network architecture 302 of Figure 10 except that as shown in Figure 17, device 110 also includes a service usage monitor 119 (e.g., agent/function) in the secure mobile enterprise application environment 120. In some embodiments, the service usage monitor 119 performs application monitoring that includes counting application service usage for secure data applications 124 and secure voice applications 126 (e.g., and, in some embodiments, for also counting application service usage for user applications that are not enterprise or secure enterprise applications 124 or 126). In some embodiments, counting application service usage includes counting bytes or network connection time used in communicating via the carrier access network 150 during the device's execution of monitored data applications. In some embodiments, counting application service usage includes counting voice network connection time used in communicating via the carrier access network 150 during the device's execution of monitored voice applications. In some embodiments, the service usage monitor 119 performs application monitoring that further includes classifying application service usage for secure enterprise applications 124, 126 (e.g., classifying various secure enterprise applications 124, 126 and in some embodiments, including ambient services classification/determination, by application/service usage activity such as based on application name or using signed code/hash techniques, by time of day/day of week, enterprise server, destinations, enterprise intranet, and/or other factors).

[00108] In some embodiments, the carrier usage accounting server 154 communicates (e.g., using secure communication techniques) with the service usage monitor 119 to mediate billing/charging and credit reports, for example, using the various approaches and techniques as described herein.

[00109] In some embodiments, the service usage monitor 119 and/or another function/agent executed in the secure mobile enterprise application environment 120 of the device 110 block user access for non-enterprise activities that the user has not agreed to pay for.

[00110] Because the enterprise service usage is monitored by the device network elements in the embodiments depicted in Figure 17, various service accounting or billing policies are available to the enterprise or carrier. For example, the amount of service usage resulting from

enterprise services that occur during roaming conditions may be accounted for even when the carrier network does not receive detailed classification of service usage from roaming network partners. The business rules programmed into the service usage reconciliation server 158 that are determined by the enterprise service activity policy set can break-out enterprise service related roaming charges separate from consumer service related roaming charges. In addition, in some embodiments, the device secure mobile enterprise environment includes an access control function so that the access control policies specified in the enterprise service activity policy set can be enforced on roaming networks that have access that is not controlled by the carrier home network.

[00111] For example, the allowances provided by the enterprise service activity policy set can be programmed so that the allowances changed depending on the availability of a particular network or set of networks, the time of day, the congestion state of a network, or the current cost of service on the network. As another example, if the carrier home network is not available and only a roaming network is available, the allowance can be decreased or removed. As yet another example, if a certain network type is not available but another network type is (e.g., 2G is available instead of 3G or 3G is available instead of 4G), then the allocation can be reduced. As yet a further example, if a variable charging policy is in place with the carrier for access when the network is busy or during certain times of day, then the enterprise sponsored allowance can be reduced during times of higher charging. As described herein, in some embodiments, an active network detection function can be included on the device to assist the network policy enforcement to determine the type of network the device is connected to or to determine if the device is on a home or roaming network. As also described herein, in some embodiments, a network busy state monitor function can be included on the device to assist the network policy enforcement to determine the network busy state or state of network congestion.

Carrier Managed Billing Allocation With Device Mobile Enterprise Services Application Environment and Mobile Services Gateway Server With Service Usage Monitoring In Carrier Network, On Device, And In Enterprise Mobile Services Gateway Server

[00112] **Figure 18** illustrates a functional diagram of another network architecture 401 for providing enterprise and consumer billing allocation for wireless communication device service

usage activities in accordance with some embodiments. The network architecture 401 of Figure 18 is similar to the network architecture 400 of Figure 17, except that in the network architecture 401 of Figure 18 the enterprise mobile services gateway server 172 includes a mobile server usage counter 179, and the enterprise service usage reports from this function are sent to the service usage reconciliation 158. In some embodiments, various specialized needs of monitoring, recording, and reporting enterprise service usage are confined to the special purpose enterprise mobile services gateway/server 172.

**Enterprise Managed Billing Allocation With Device Mobile Enterprise Services
Application Environment and Mobile Services Gateway Server With Service Usage
Monitoring On Device And In Enterprise Mobile Services Gateway Server**

[00113] **Figure 19** illustrates a functional diagram of another network architecture 402 for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments. The network architecture 402 of Figure 19 is similar to the network architecture 401 of Figure 18, except that in the network architecture 402 of Figure 19 does not include the service usage feed from the carrier gateway/home agent 152 and service usage reconciliation 158 relies solely on a device service usage feed from device 110 usage monitors 119 and the secure enterprise mobile services gateway/server 172 mobile service usage monitor 179. In some embodiments, the service usage reconciliation 158 and enterprise service usage accounting server 159 are under the control of the enterprise or the carrier. For example, an enterprise entity can establish enterprise service and consumer service usage allocation accounting without the need to tie into the carrier network for usage feeds and usage accounting. Using various techniques described herein, an enterprise service usage credit can be determined, and the determined enterprise service usage credit can be reimbursed to the device user.

**Enterprise Managed Billing Allocation With Device Mobile Enterprise Services
Application Environment and Mobile Services Gateway Server With Service Usage
Monitoring On Device**

[00114] **Figure 20** illustrates a functional diagram of another network architecture 403 for providing enterprise and consumer billing allocation for wireless communication device service

usage activities in accordance with some embodiments. The network architecture 403 of Figure 20 is similar to the network architecture 402 of Figure 19, except that in the network architecture 403 of Figure 20 service usage reconciliation 158 receives feeds from device 110 service usage monitors 119 and there is no feed from the secure enterprise mobile services gateway server.

Enterprise Usage Credit With Device Mobile Enterprise Services Application Environment and Mobile Services Gateway Server With Service Usage Monitoring On Device And In Enterprise Mobile Services Gateway Server

[00115] **Figure 21** illustrates a functional diagram of another network architecture 404 for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments. The network architecture 404 of Figure 21 is similar to the network architecture 402 of Figure 19, except that in the network architecture 404 of Figure 21 there is not service usage monitor function 119 in the user services application environment 122 providing service usage reports/information to the service usage reconciliation 158, and the enterprise usage accounting server 159 only generates enterprise usage records 156.

Enterprise Usage Credit With Device Mobile Enterprise Services Application Environment and Mobile Services Gateway Server With Usage Monitoring On Device

[00116] **Figure 22** illustrates a functional diagram of another network architecture 405 for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments. The network architecture 405 of Figure 22 is similar to the network architecture 404 of Figure 21, except that in the network architecture 405 of Figure 22 does not include the mobile server usage monitor 179 providing enterprise service usage reports/information to the service usage reconciliation 158.

Device Configurations With Service Usage Monitoring and Reporting

[00117] In some embodiments, the secure enterprise mobile services application 125 and the network stack 121 can be implemented in the access modem 129, as described below with respect to Figures 23 through 26.

[00118] **Figure 23** illustrates a functional diagram of a secure device application architecture with device based service usage monitoring (and in some embodiments, access control) for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments. Figure 23 is similar to Figure 13 except that in Figure 23 a usage monitor 119 is provided as shown, and the secure enterprise mobile services application 125 and the network stack 121 can be implemented in the access modem 129 as also shown.

[00119] **Figure 24** illustrates a functional diagram of a secure device virtual machine architecture with device based service usage monitoring (and in some embodiments, access control) for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments. Figure 24 is similar to Figure 14 except that in Figure 24 a usage monitor 119 is provided as shown, and the secure enterprise mobile services application 125 and the network stack 116 can be implemented in the access modem 129 as also shown.

[00120] **Figure 25** illustrates a functional diagram of a secure device hardware execution partition architecture with device based service usage monitoring (and in some embodiments access control) for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments. Figure 25 is similar to Figure 15 except that in Figure 25 a usage monitor 119 is provided as shown, and the secure enterprise mobile services application 125 and the network stack 116 can be implemented in the access modem 129 as also shown.

[00121] **Figure 26** illustrates a functional diagram of a secure device service processor architecture with device based service usage monitoring (and in some embodiments, access control) for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments. Figure 263 is similar to Figure 16 except that in Figure 26 a usage monitor 119 is provided as shown at the secure enterprise mobile services application 125, service processor framework 139, and the service processor kernel program 138, each of which can be implemented in the access modem 129 as also shown. \

Process Flows For Providing Enterprise And Consumer Billing Allocation For Wireless Communication Device Service Usage Activities

[00122] **Figure 27** illustrates a flow diagram for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments. At 402, the process begins. At 404, a service usage activity of a wireless communication device (e.g., application based service usage that uses a wireless network in which the wireless communication device has an associated service plan) is performed. In some embodiments, the monitoring is performed on the wireless communication device. In some embodiments, the monitoring is performed by a network element, such as a secure application server for monitoring enterprise applications, as described herein with respect to various embodiments. At 406, an enterprise/consumer allocation is determined. In some embodiments, the monitored service usage activity is reported to a network element that determines the enterprise/consumer allocation based on the associated service plan that includes a defined enterprise/consumer allocation based on various factors, such as can be performed by a carrier billing server as described herein with respect to various embodiments. At 408, an associated consumer account is billed for the consumer service usage. At 410, the consumer account is credited for the enterprise service usage. At 412, the process is completed.

[00123] **Figure 28** illustrates another flow diagram for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments. At 502, the process begins. At 504, a service usage activity of a wireless communication device (e.g., application based service usage that uses a wireless network in which the wireless communication device has an associated service plan) is performed. At 506, an enterprise/consumer allocation is determined. At 508, an associated enterprise account is billed for the enterprise service usage. At 510, the enterprise account is credited for the consumer service usage. At 512, the process is completed.

[00124] **Figure 29** illustrates another flow diagram for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments. At 602, the process begins. At 604, a service usage activity of a wireless communication device (e.g., application based service usage that uses a wireless network in

which the wireless communication device has an associated service plan) is performed. At 606, an enterprise/consumer allocation is determined. At 608, the enterprise service usage is reported. At 610, an expense reimbursement for the enterprise service usage is generated (e.g., by the enterprise for the consumer, who is, for example, an employee of the enterprise). At 612, the process is completed.

[00125] **Figure 30** illustrates another flow diagram for providing enterprise and consumer billing allocation for wireless communication device service usage activities in accordance with some embodiments. At 702, the process begins. At 704, a service usage activity of a wireless communication device (e.g., application based service usage that uses a wireless network in which the wireless communication device has an associated service plan) is performed. At 706, the monitored service usage is reported. At 708, an enterprise/consumer allocation is determined. At 710, a bill/charge based on the enterprise/consumer allocation is generated. At 712, the process is completed.

[00126] Although the foregoing embodiments have been described in some detail for purposes of clarity of understanding, the invention is not limited to the details provided. There are many alternative ways of implementing the invention. The disclosed embodiments are illustrative and not restrictive.

[00127] WHAT IS CLAIMED IS:

CLAIMS

1. A method, comprising:
monitoring a service usage activity of a wireless communication device; and
determining an enterprise and consumer billing allocation for the monitored service usage
5 activity.
2. The method of claim 1, wherein the determining is performed by a classifier implemented
on the wireless communication device that classifies the monitored service usage activity,
wherein the classifier is executed in a secure execution area or a secure memory of the wireless
communication device.
- 10 3. The method of claim 1, wherein the monitoring includes monitoring an enterprise
application service usage using an application server in an enterprise network.
4. The method of claim 1, wherein a secured application protects one or more enterprise
applications on the wireless communication device from unauthorized use or tampering, wherein
the one or more enterprise applications include one or more of the following: email, calendar,
15 contacts, intranet access, and enterprise specified applications.
5. The method of claim 1, further comprising:
associating the wireless communication device and/or an authorized user of the wireless
communication device with an enterprise account.
6. The method of claim 1, further comprising:
20 associating the monitored service usage activity of the wireless communication device
with one or more enterprise services, wherein the one or more enterprise services include
enterprise paid for services.
7. The method of claim 1, further comprising:
crediting an associated consumer account for service usage allocated to an enterprise
25 account.
8. The method of claim 1, further comprising:
billing an enterprise for service usage allocated to an enterprise account.
9. The method of claim 1, further comprising:

reporting to an enterprise, enterprise service usage allocated to an enterprise account, wherein the enterprise account is associated with the enterprise.

10. The method of claim 1, further comprising:

reporting to an enterprise, consumer service usage allocated to an enterprise account,
5 wherein the enterprise account is associated with the enterprise.

11. The method of claim 1, further comprising:

reporting to an enterprise service usage allocated to an enterprise account, wherein the enterprise provides an expense reimbursement to a consumer for a cost of the service usage allocated to the enterprise account.

10 12. The method of claim 1, further comprising:

crediting an associated enterprise account for service usage allocated to a consumer account.

13. The method of claim 1, further comprising:

billing a consumer for service usage allocated to a consumer account.

15 14. The method of claim 1, further comprising:

reporting to an enterprise, service usage allocated to a consumer account.

15. The method of claim 1, further comprising:

reporting to an enterprise and a consumer, service usage allocated to a consumer account.

16. The method of claim 1, further comprising:

20 reporting to an enterprise service usage allocated to a consumer account, wherein the enterprise deducts a cost for the service usage allocated to the consumer account as an expense from a paycheck of an employee associated with the consumer account.

17. A method, comprising:

monitoring a service usage activity of a wireless communication device; and
reporting the monitored service usage activity to a network element, wherein the network
element determines an enterprise and consumer billing allocation for the monitored service usage
activity.

- 5 18. A system, comprising:
 a processor configured to:
 monitor a service usage activity of a wireless communication device; and
 determine an enterprise and consumer billing allocation for the monitored service
 usage activity; and
10 a memory coupled to the processor and configured to provide the processor with
instructions.

19. A computer program product, the computer program product being embodied in a
computer readable storage medium and comprising computer instructions for:
 monitoring a service usage activity of a wireless communication device; and
15 determining an enterprise and consumer billing allocation for the monitored service usage
activity.

20. A method, comprising:
 providing a service design center for configuring an enterprise and consumer billing
allocation of monitored service usage activities for a plurality of wireless communication devices
20 associated with an enterprise account; and
 implementing the configured enterprise and consumer billing allocation for monitored
service usage activities for the plurality of wireless communication devices associated with the
enterprise account.

25

**ENTERPRISE AND CONSUMER BILLING ALLOCATION FOR
WIRELESS COMMUNICATION DEVICE SERVICE USAGE ACTIVITIES**

ABSTRACT OF THE DISCLOSURE

[00128] Enterprise and consumer billing allocation for wireless communication device service usage activities is provided. In some embodiments, enterprise and consumer billing allocation for wireless communication device service usage activities includes monitoring a service usage activity of a wireless communication device, and determining an enterprise and consumer billing allocation for the monitored service usage activity. In some embodiments, enterprise and consumer billing allocation for wireless communication device service usage activities includes monitoring a service usage activity of a wireless communication device, and reporting the monitored service usage activity to a network element, in which the network element determines an enterprise and consumer billing allocation for the monitored service usage activity. In some embodiments, enterprise and consumer billing allocation for wireless communication device service usage activities includes providing a service design center for configuring an enterprise and consumer billing allocation of monitored service usage activities for a plurality of wireless communication devices associated with an enterprise account, and implementing the configured enterprise and consumer billing allocation for monitored service usage activities for the plurality of wireless communication devices associated with the enterprise account.

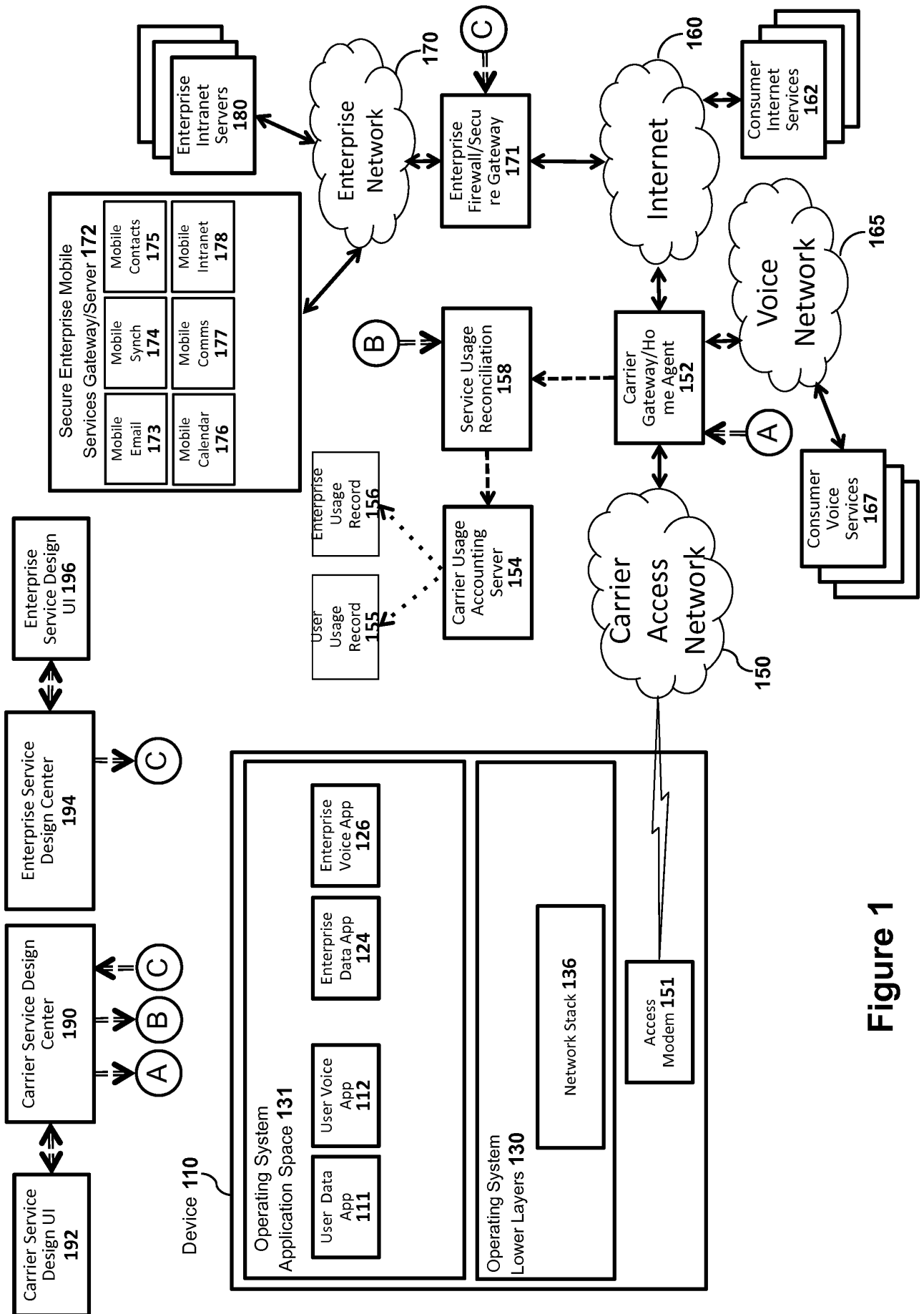


Figure 1

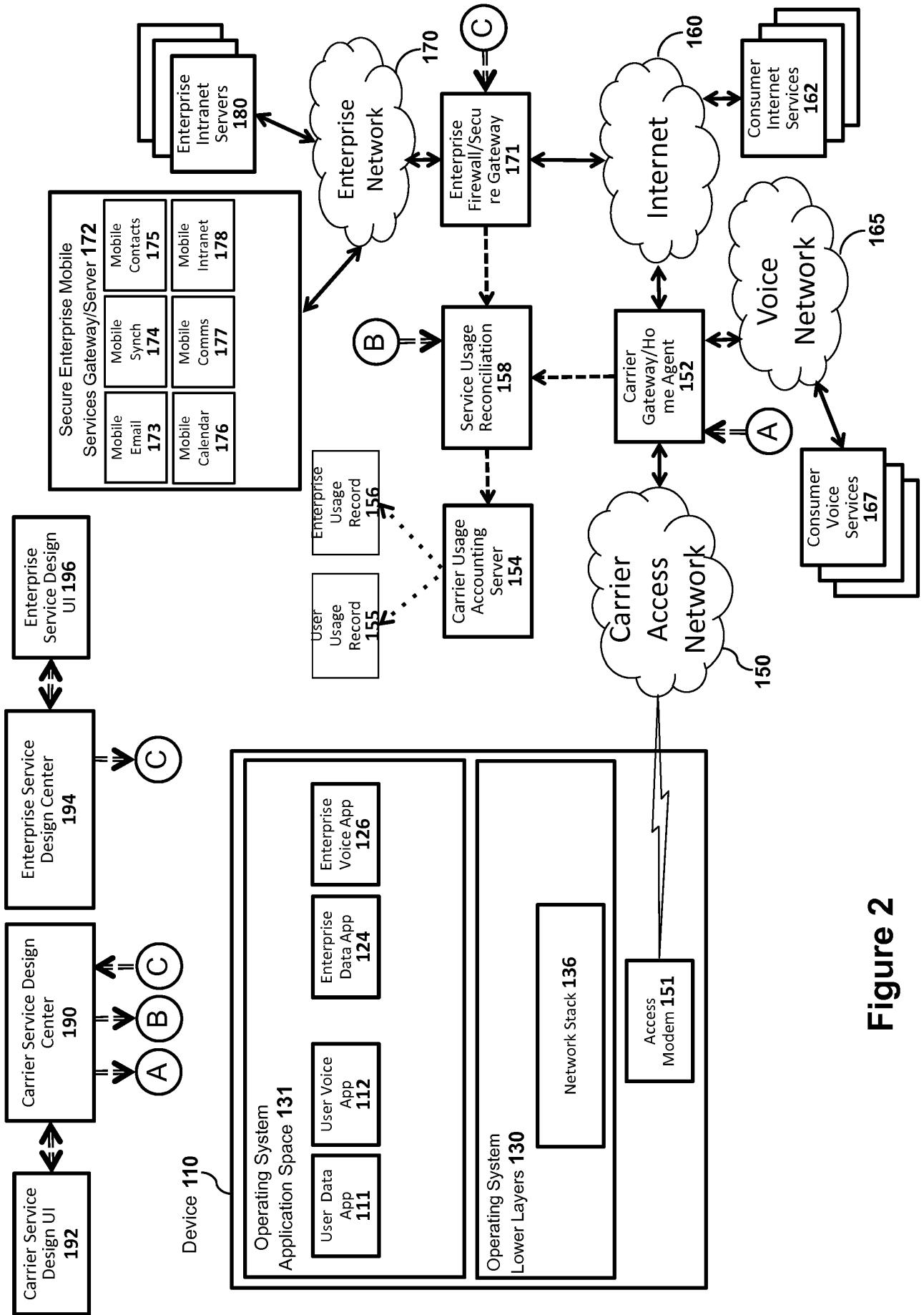


Figure 2

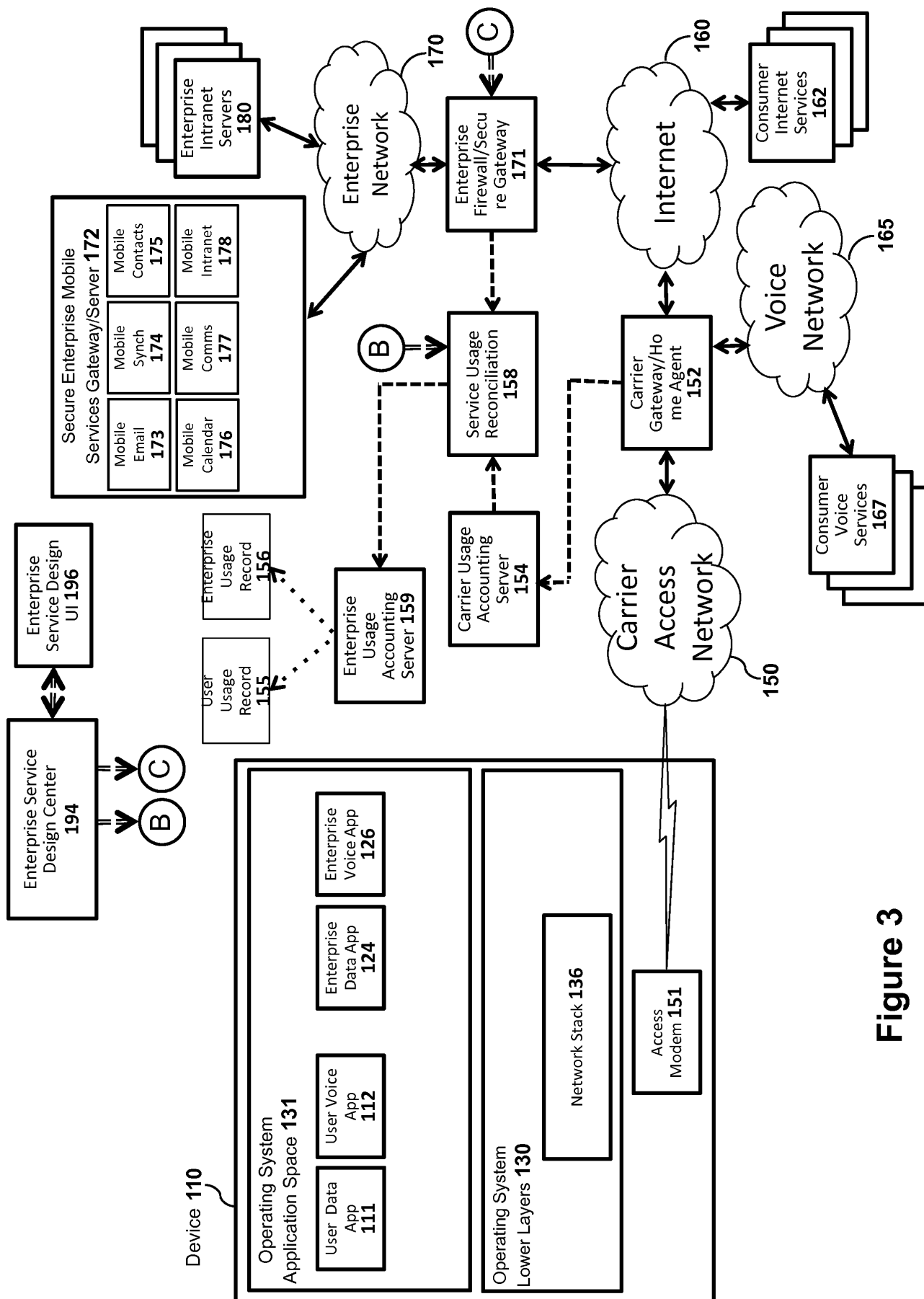
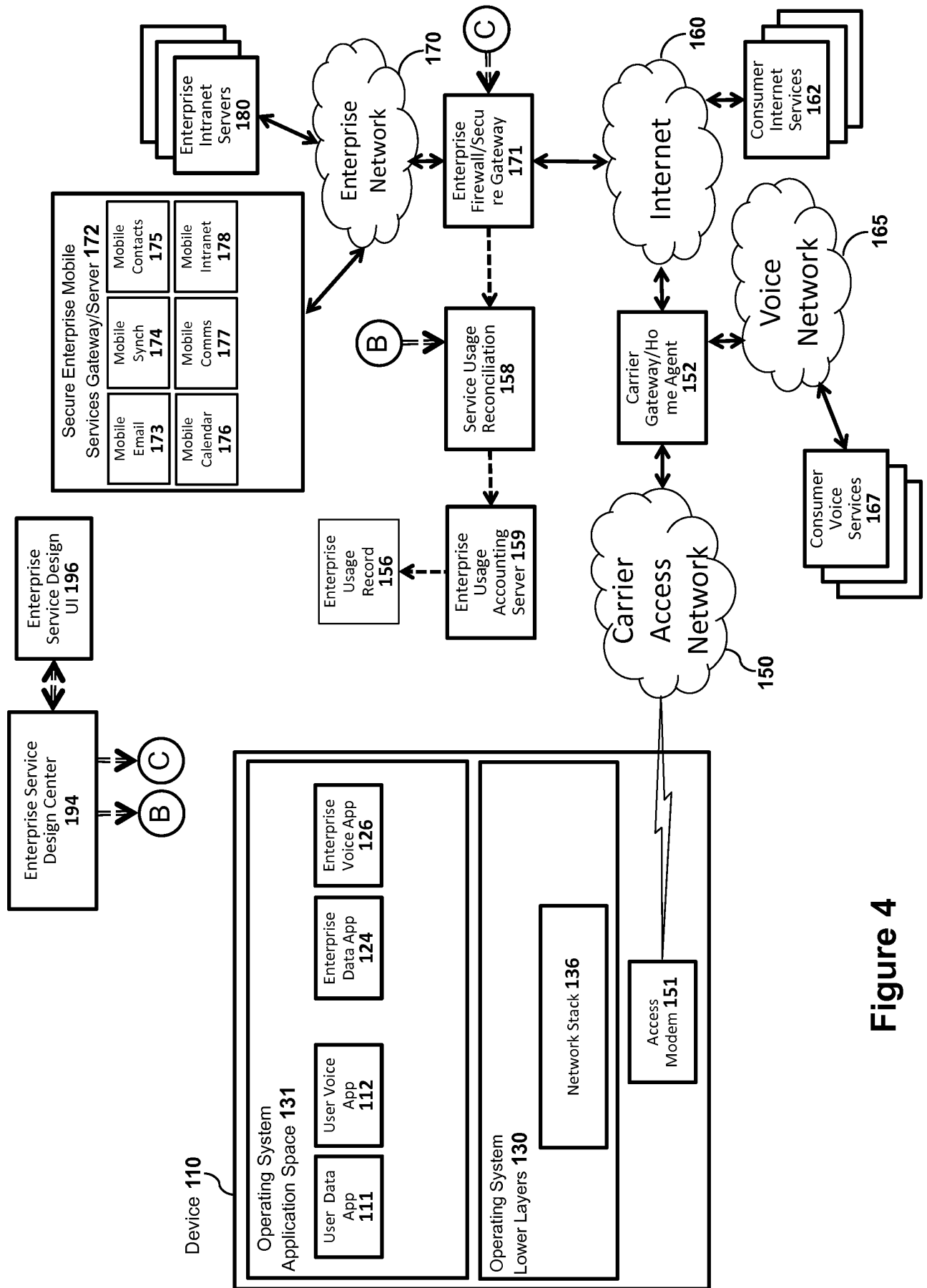


Figure 3



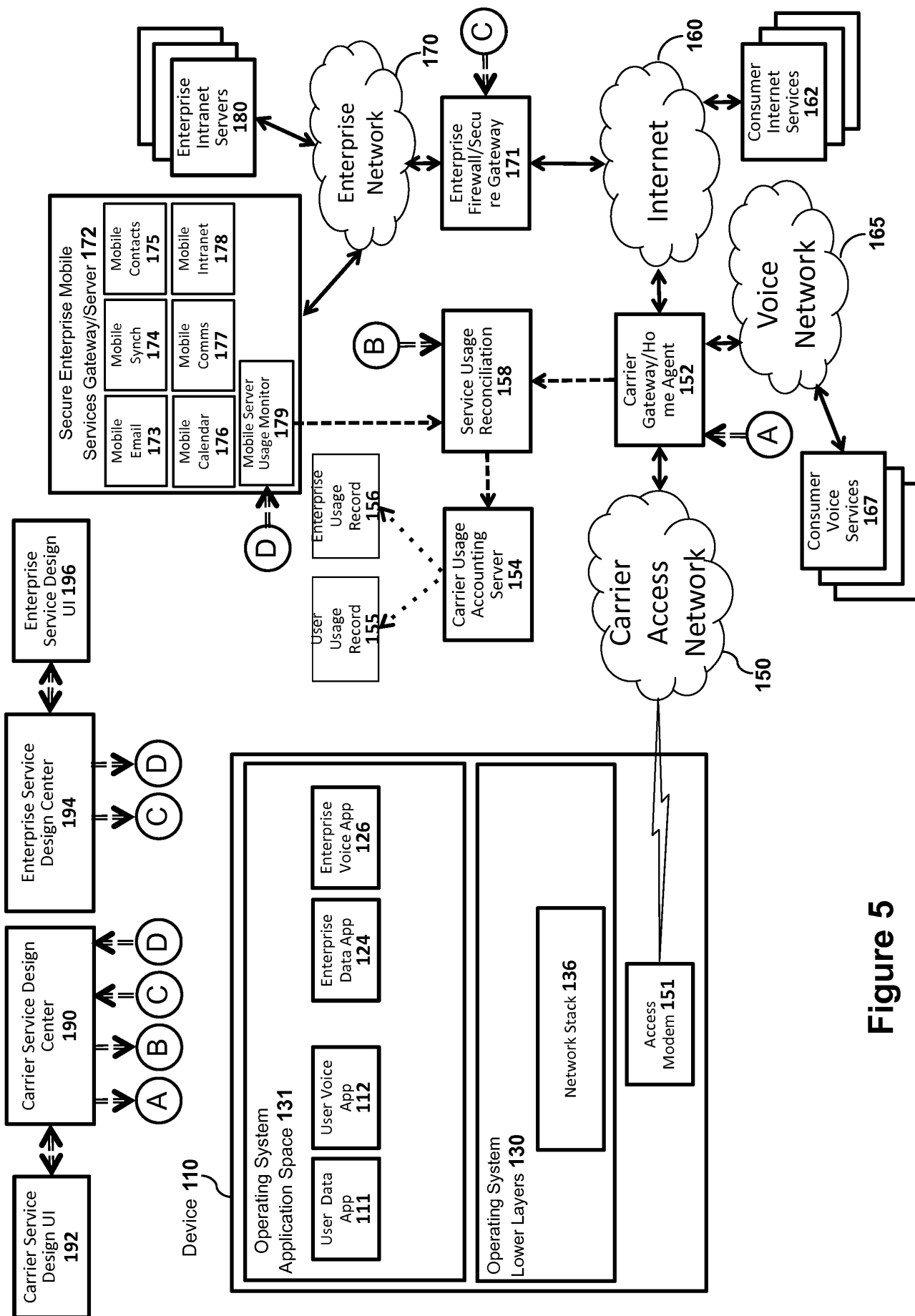
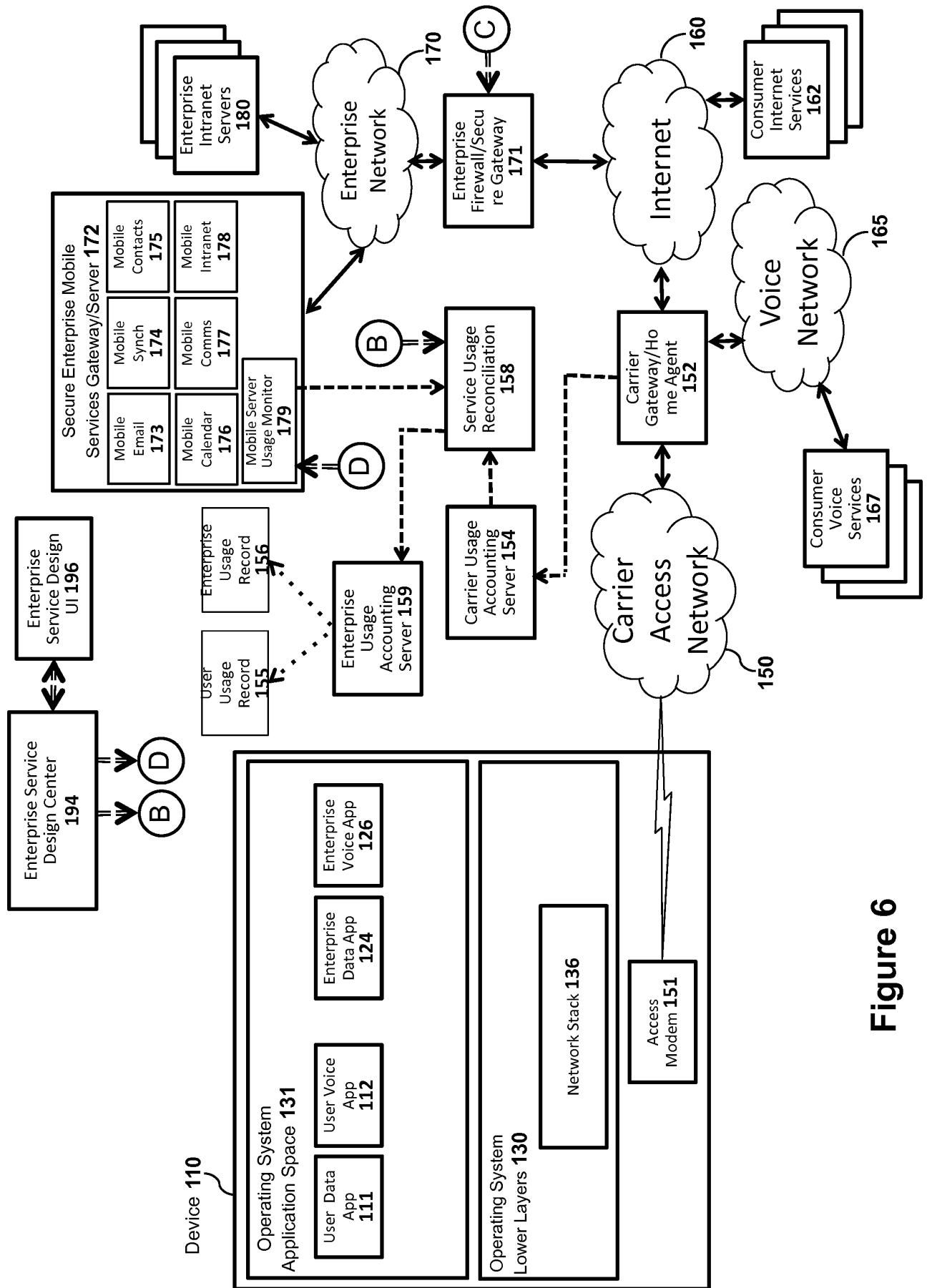


Figure 5



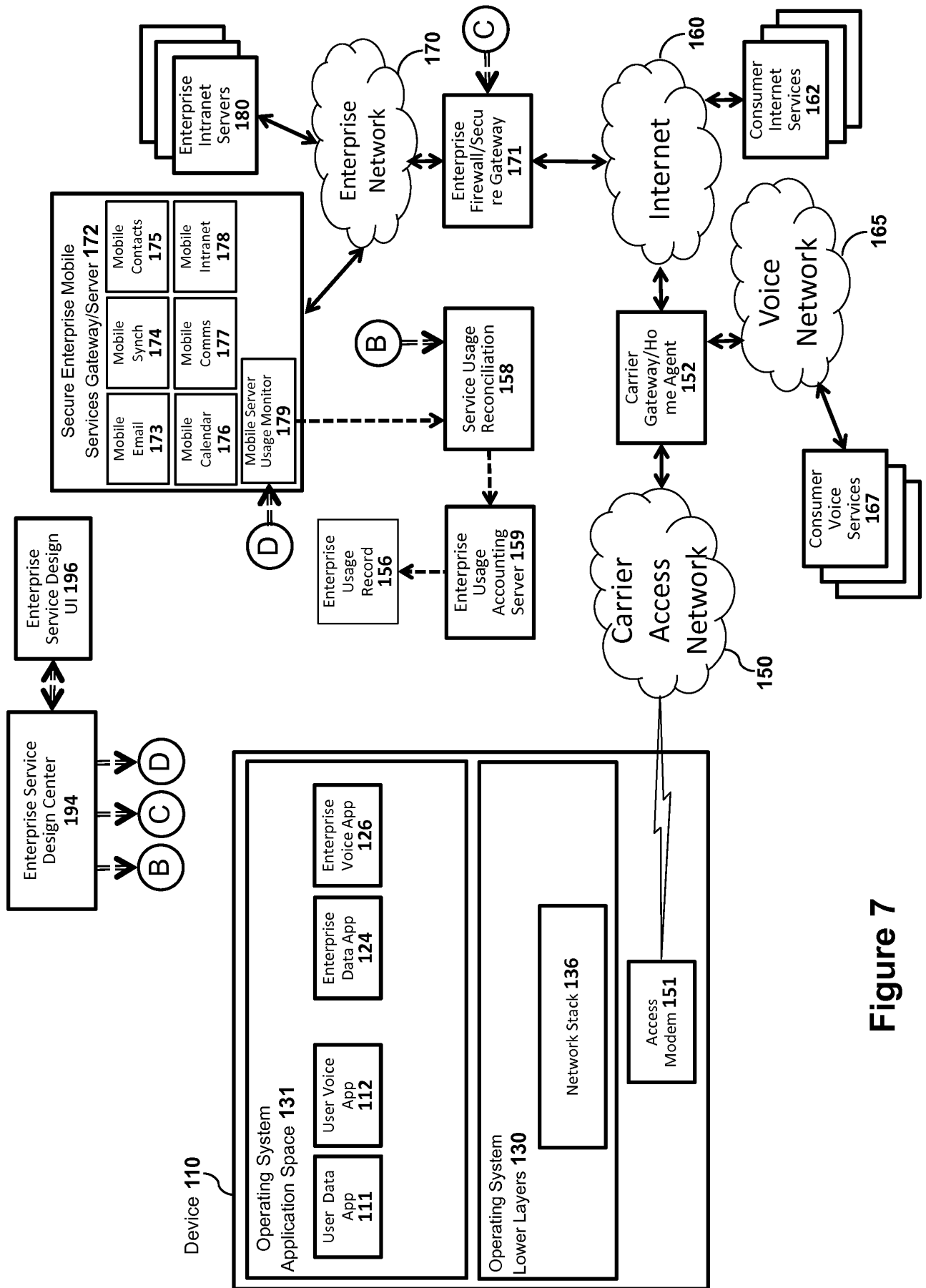


Figure 7

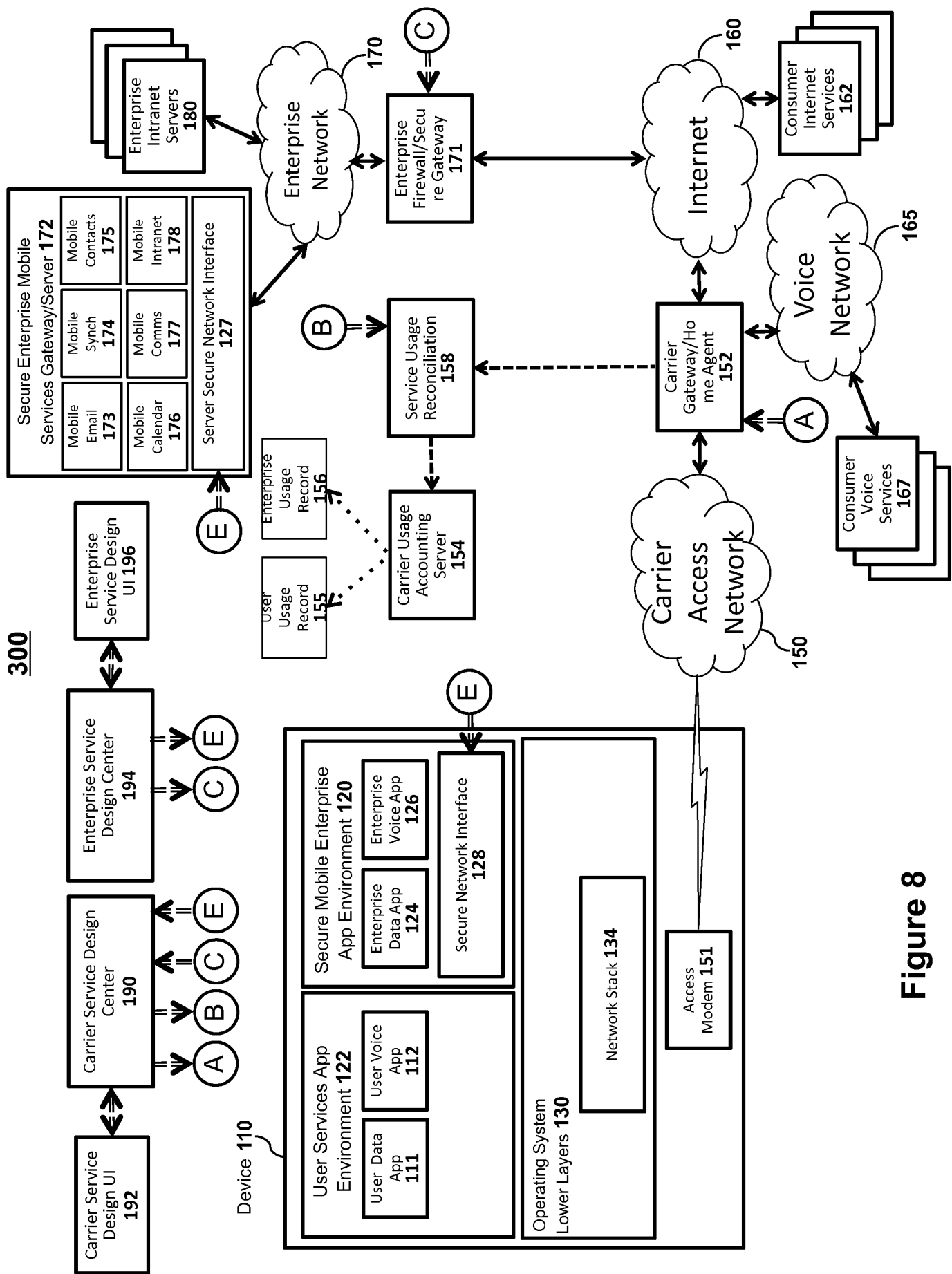


Figure 8

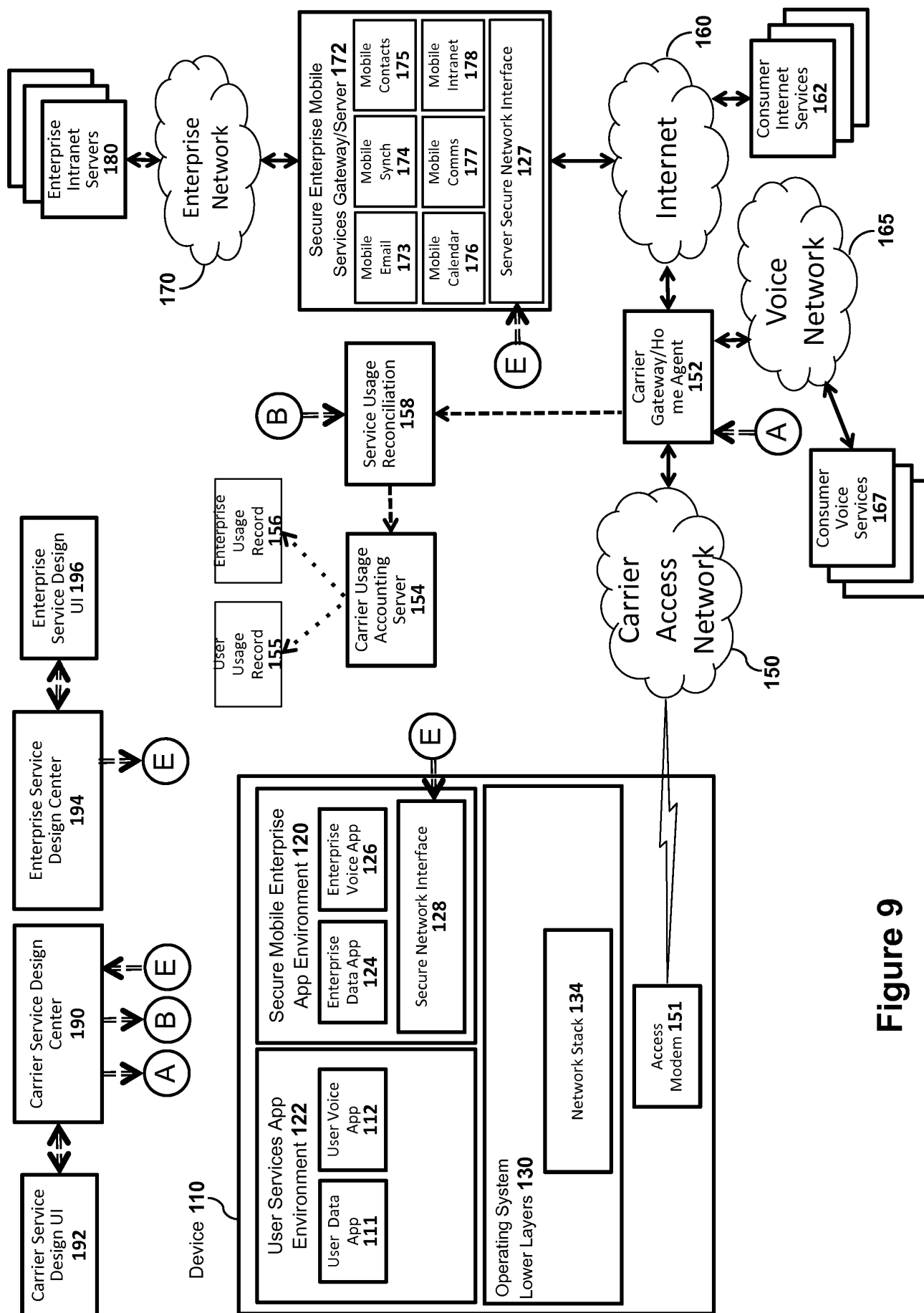


Figure 9

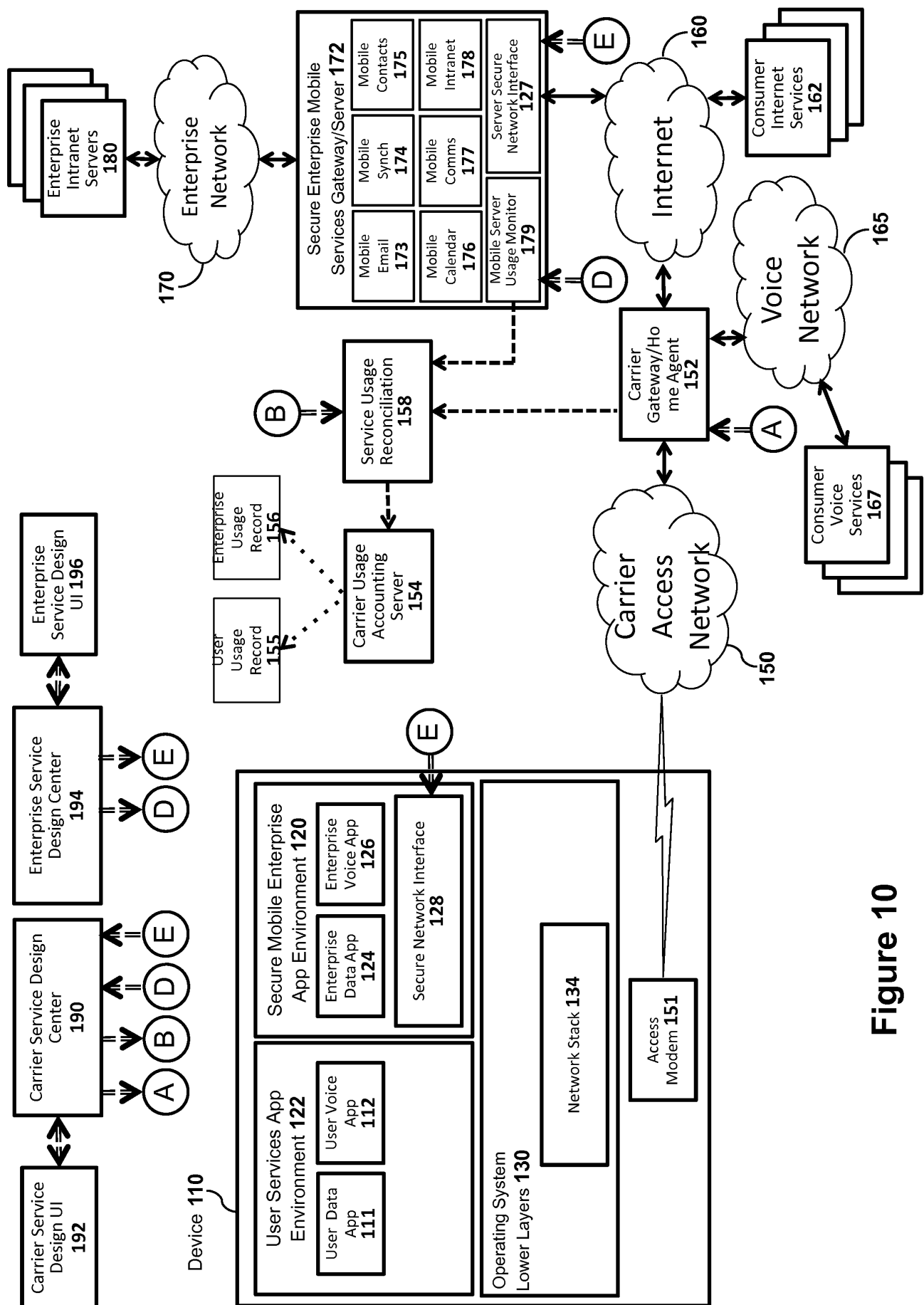


Figure 10

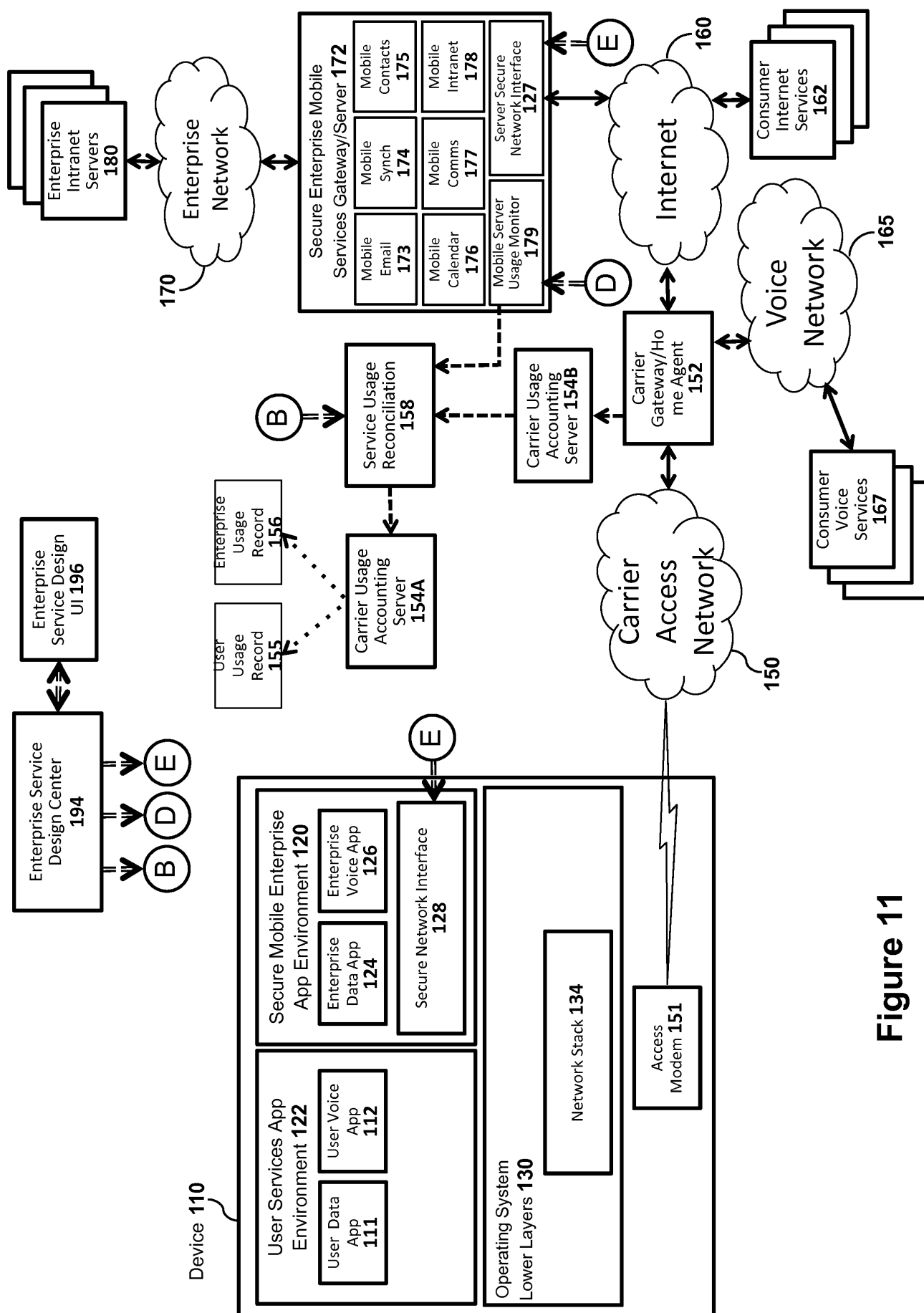


Figure 11

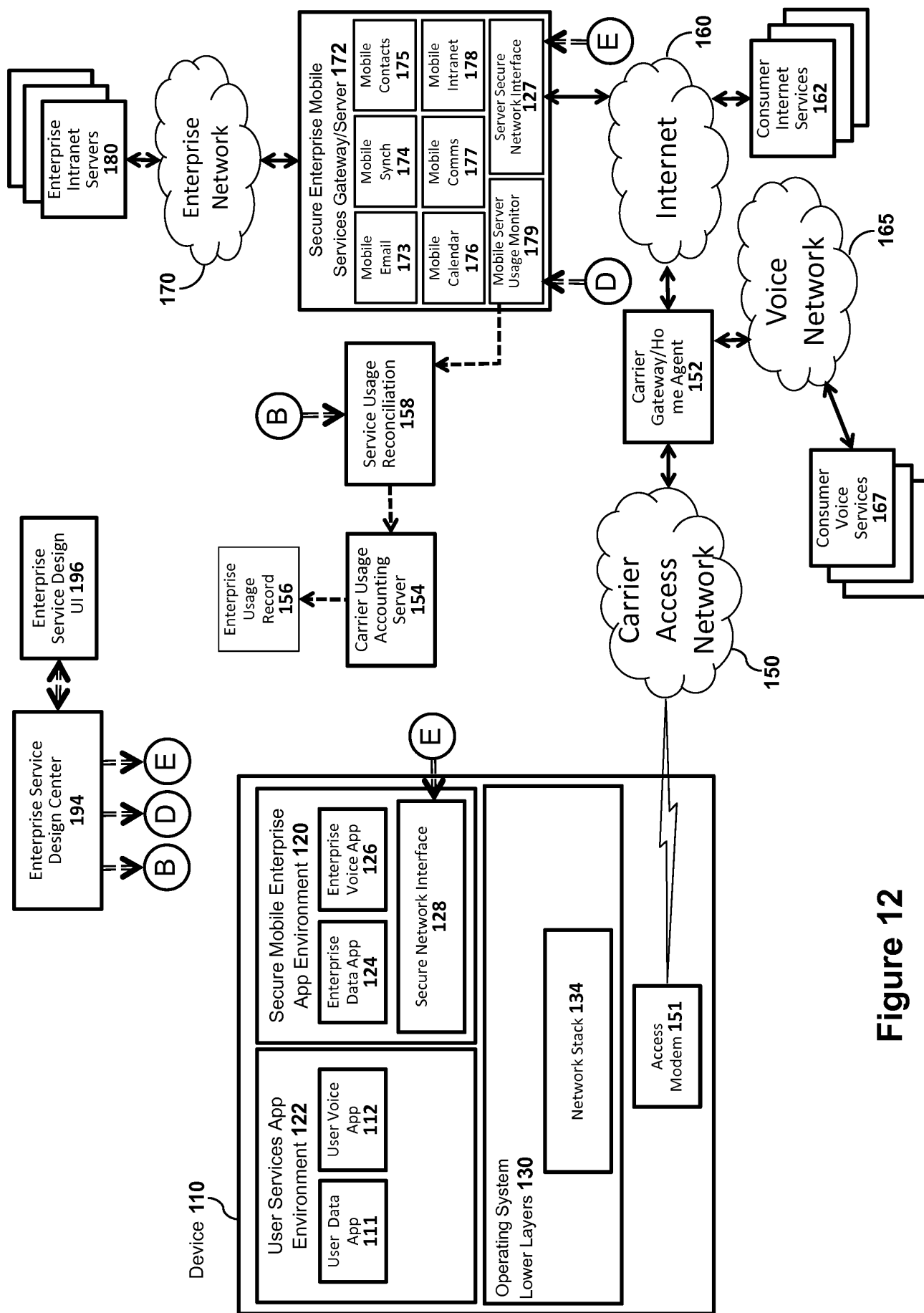


Figure 12

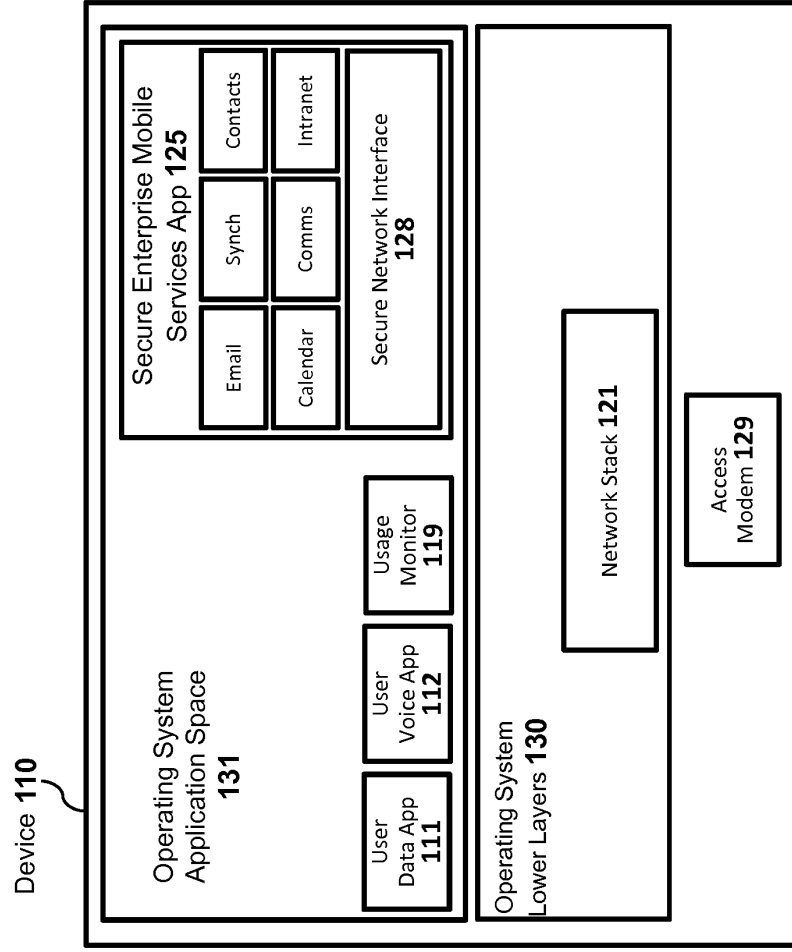


Figure 13

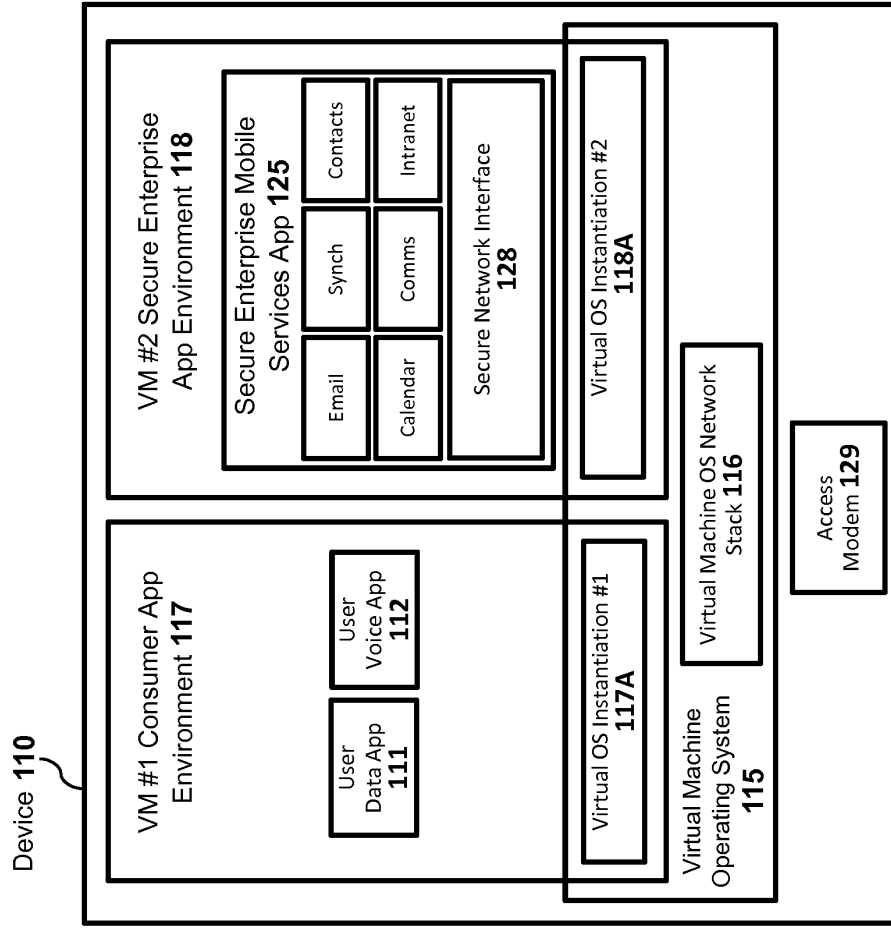


Figure 14

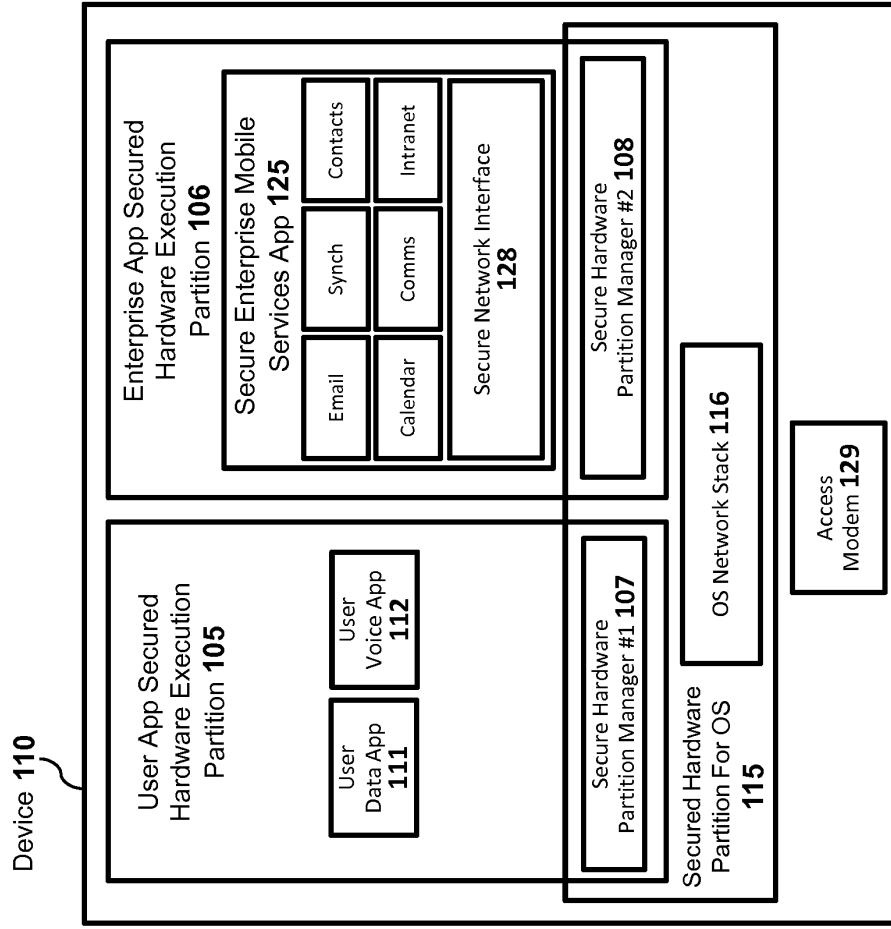


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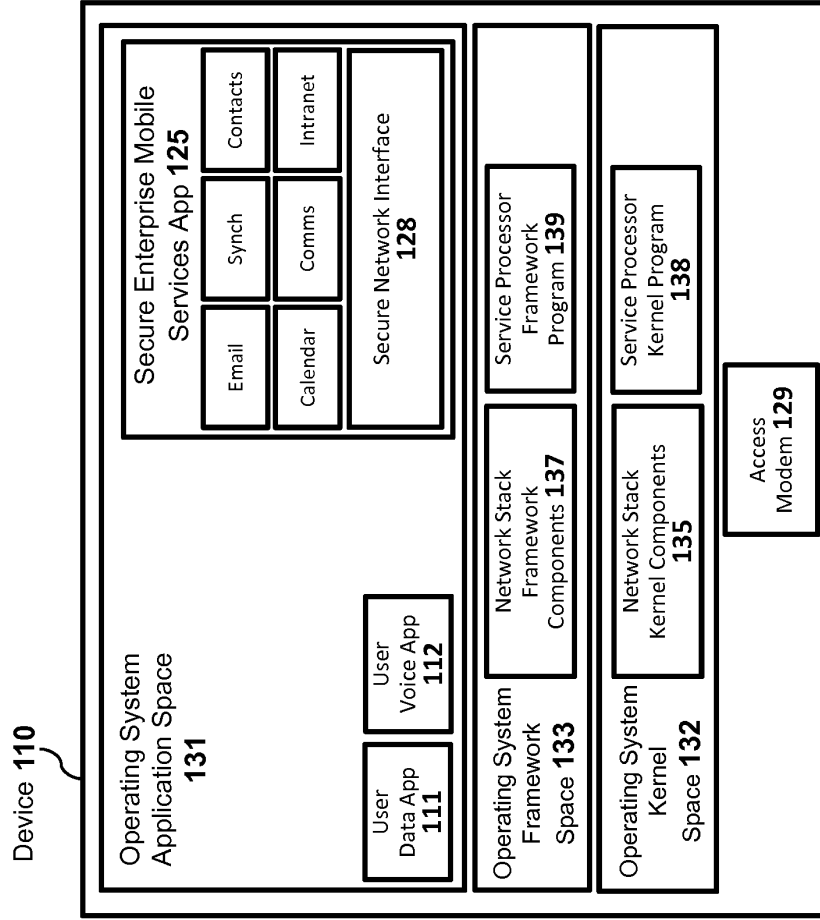


Figure 16

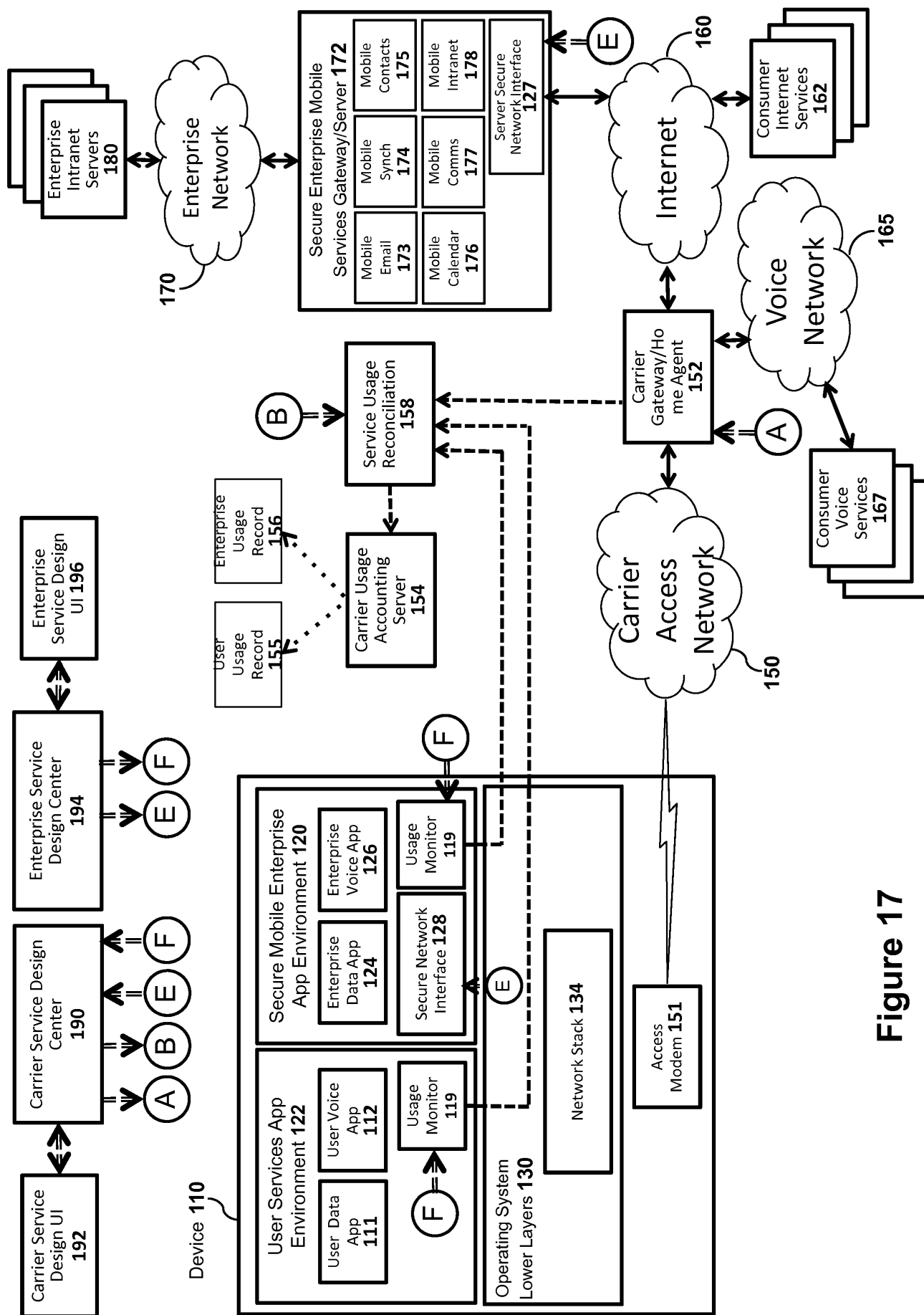


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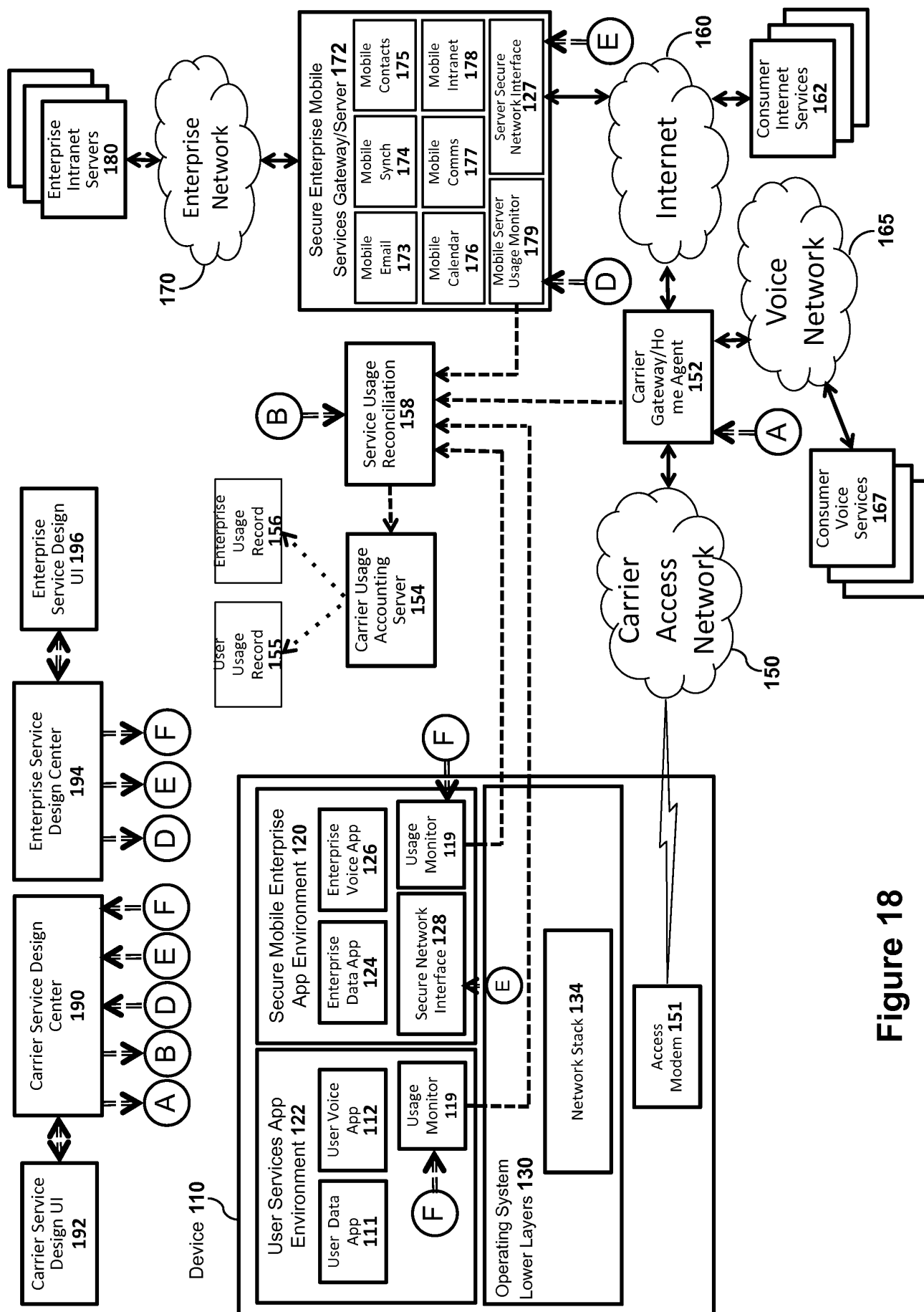


Figure 18

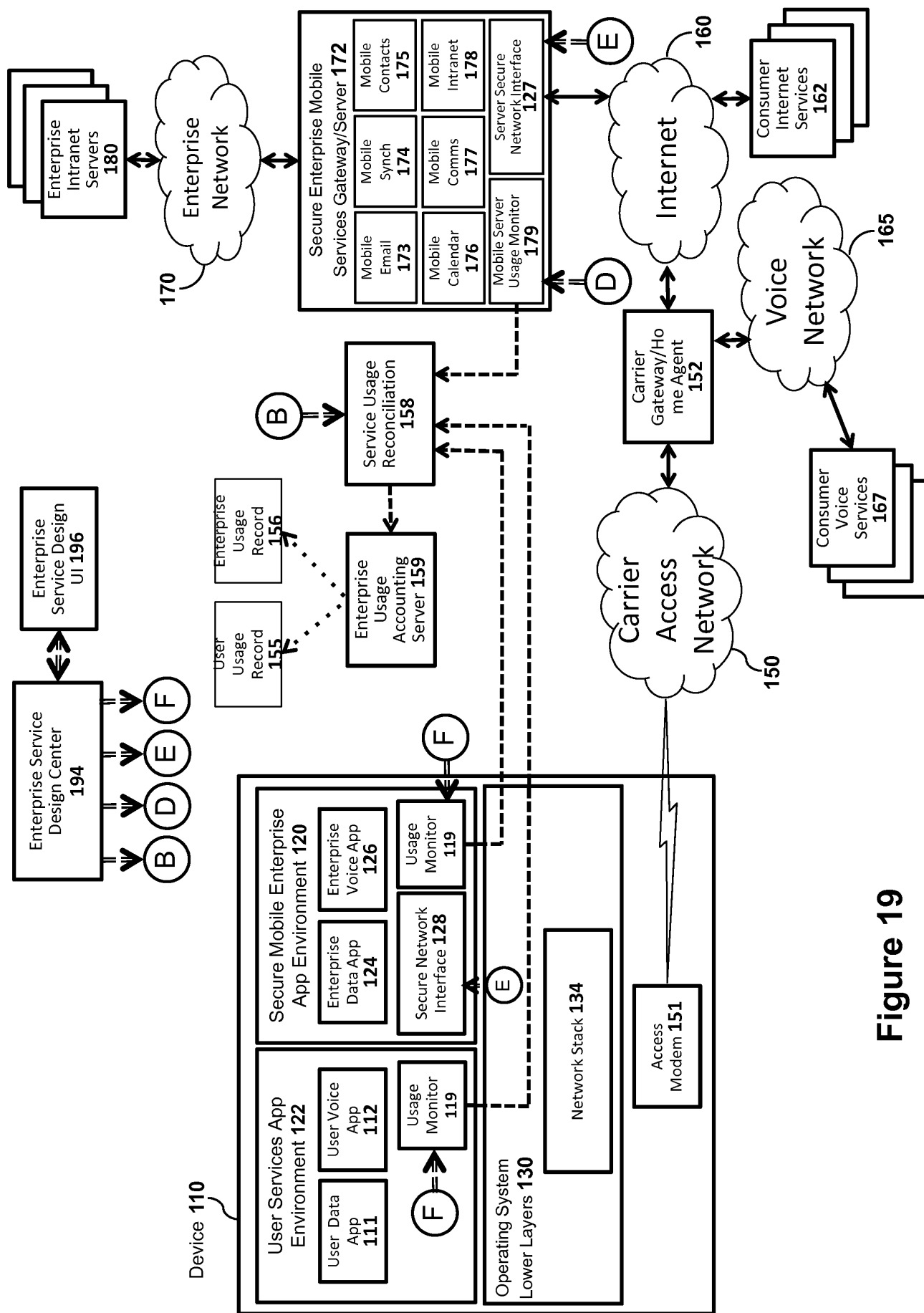


Figure 19

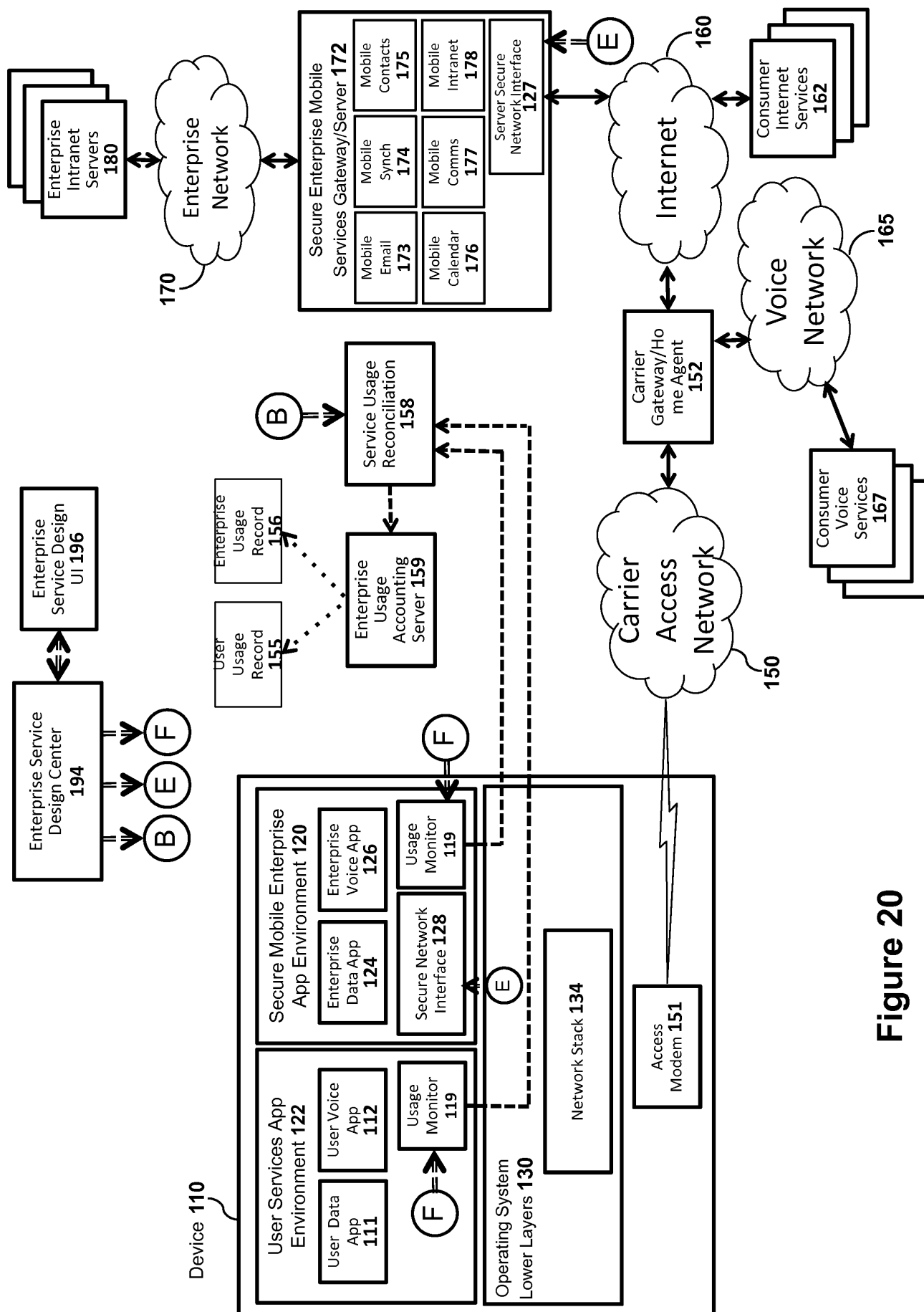
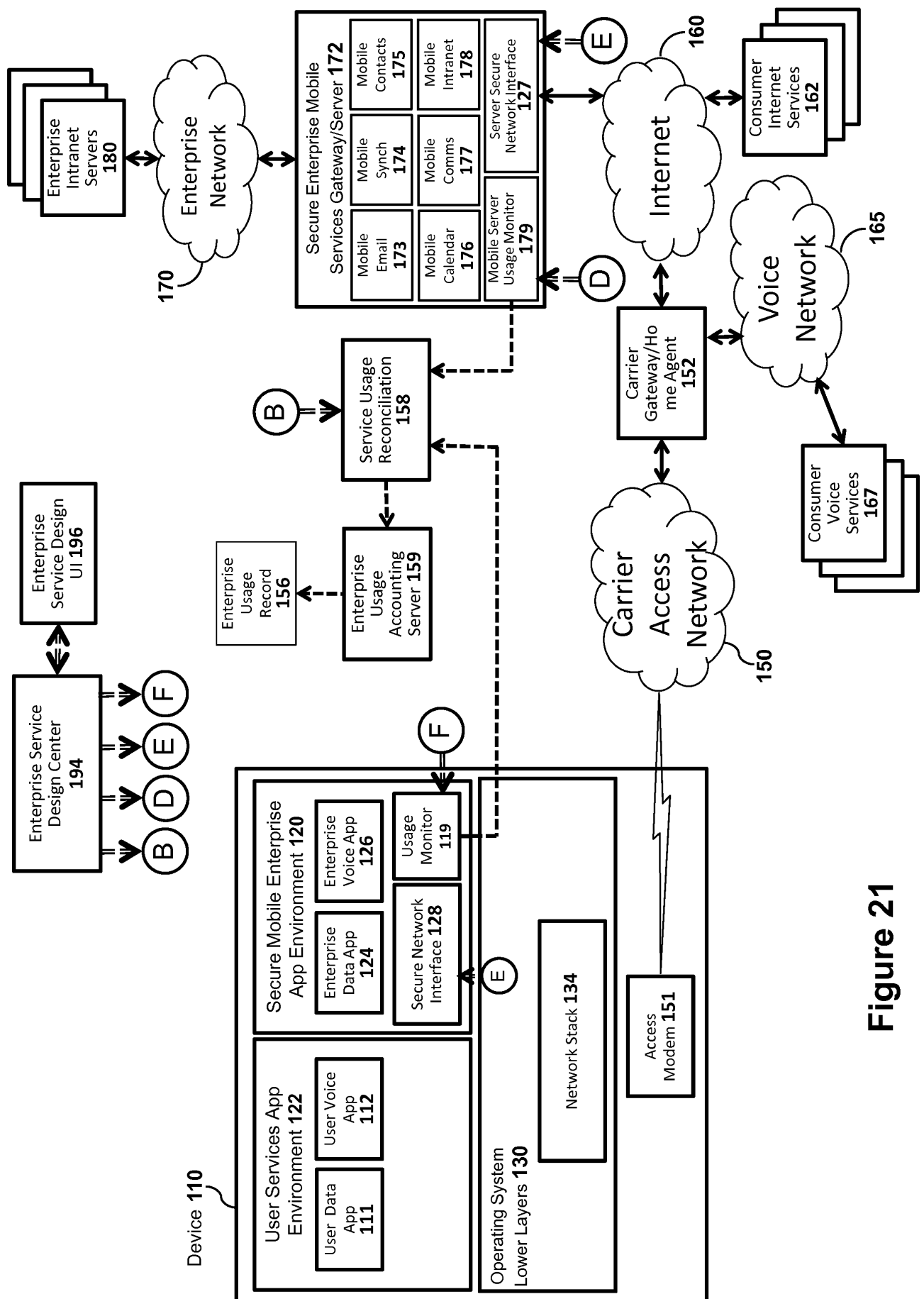


Figure 20



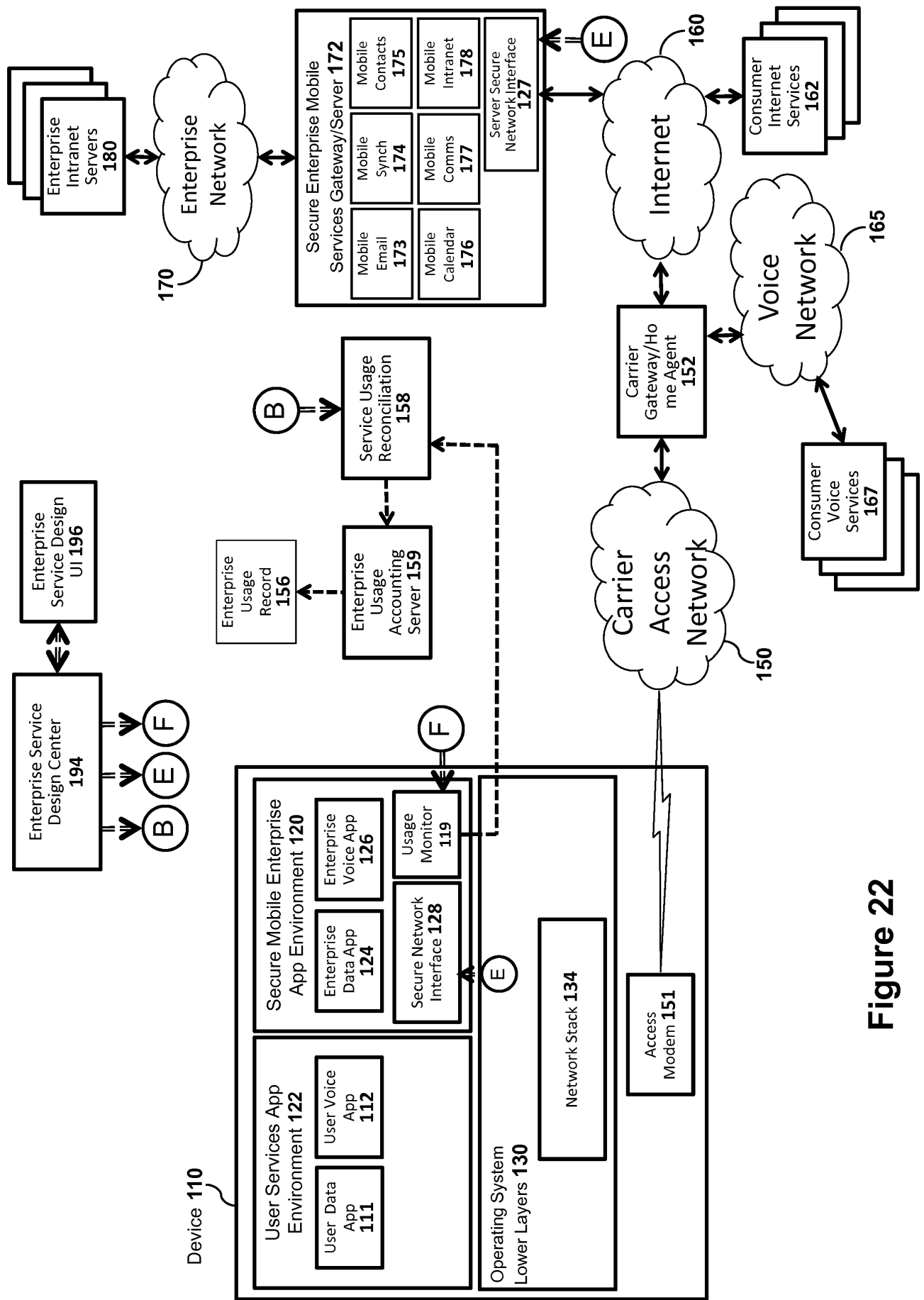


Figure 22

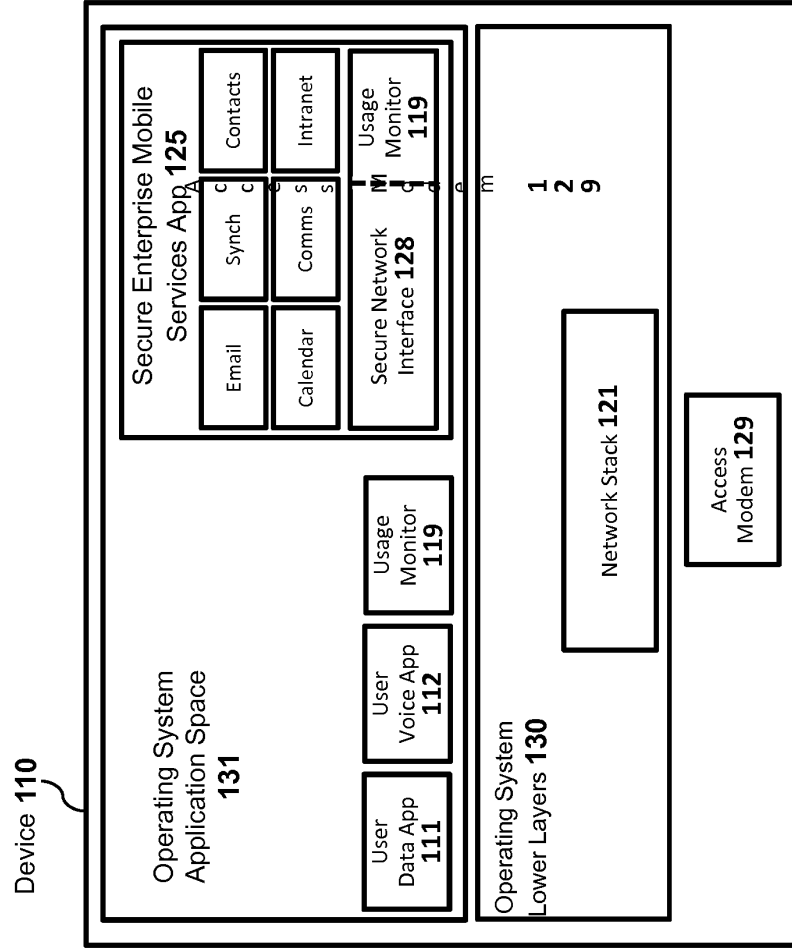


Figure 23

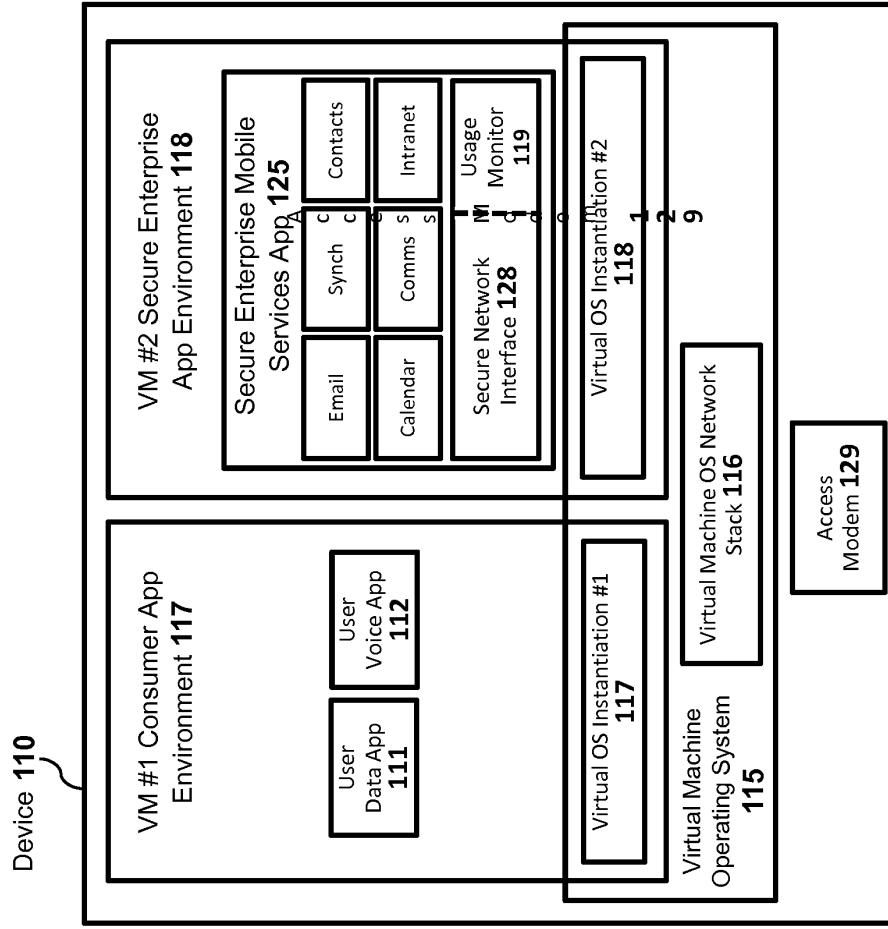


Figure 24

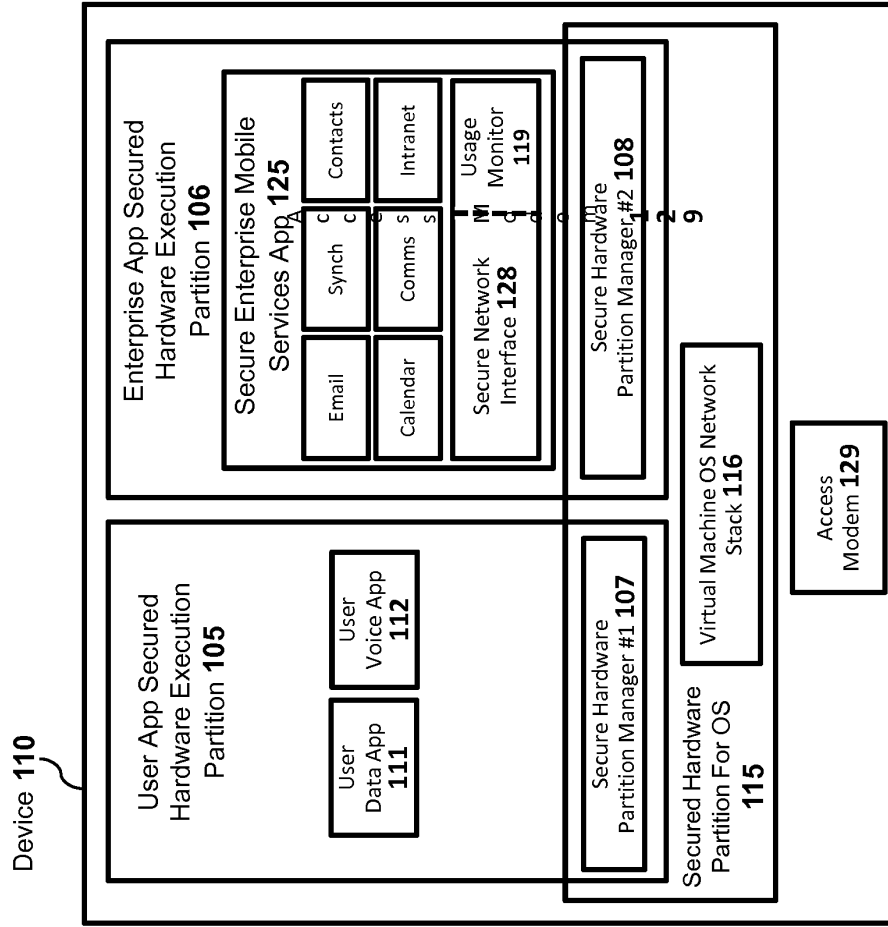


Figure 25

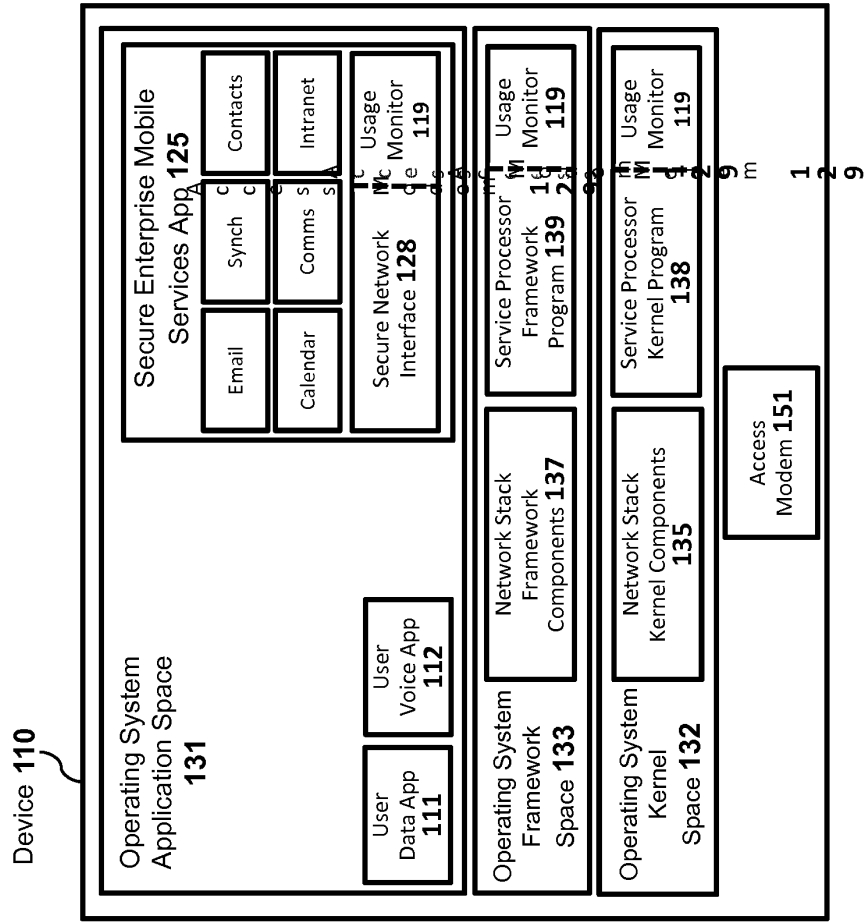


Figure 26

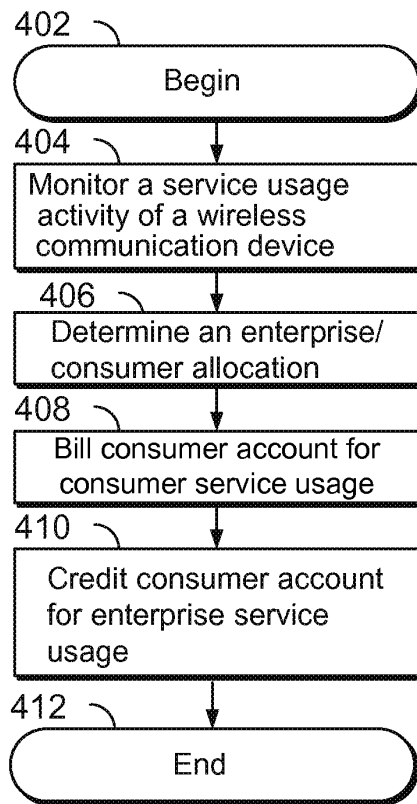


FIG. 27

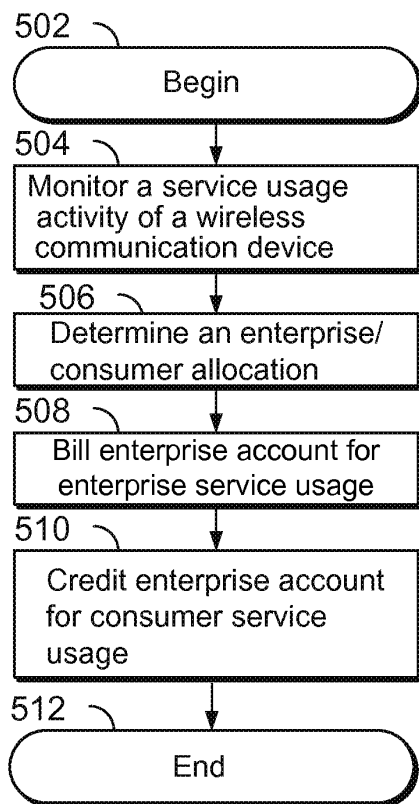


FIG. 28

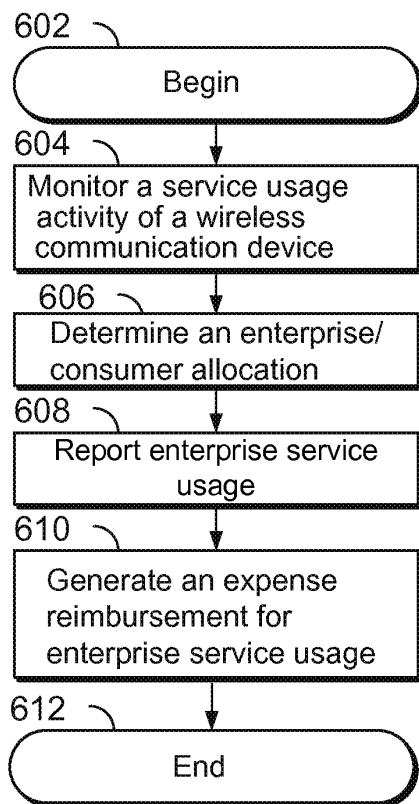


FIG. 29

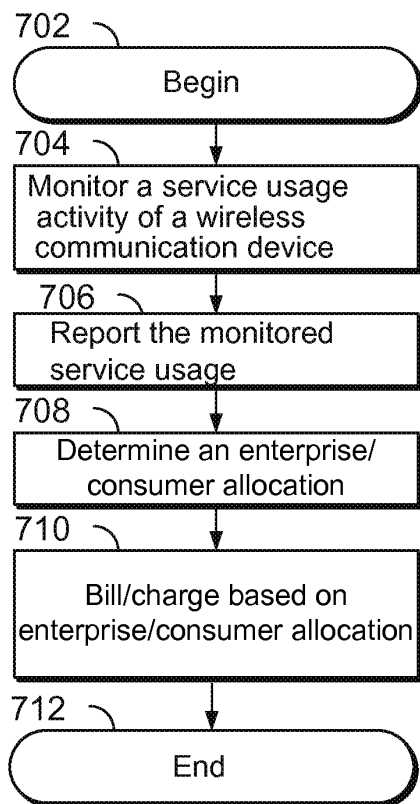


FIG. 30

Electronic Patent Application Fee Transmittal				
Application Number:				
Filing Date:				
Title of Invention:		ENTERPRISE AND CONSUMER BILLING ALLOCATION FOR WIRELESS COMMUNICATION DEVICE SERVICE USAGE ACTIVITIES		
First Named Inventor/Applicant Name:		Gregory G. Raleigh		
Filer:		Michael J. Schallop/Veronica Pula		
Attorney Docket Number:		RALEP037+		
Filed as Large Entity				
Provisional Filing Fees				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Provisional application filing	1005	1	220	220
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Miscellaneous:				
Total in USD (\$)				220

Electronic Acknowledgement Receipt	
EFS ID:	8513700
Application Number:	61387243
International Application Number:	
Confirmation Number:	2228
Title of Invention:	ENTERPRISE AND CONSUMER BILLING ALLOCATION FOR WIRELESS COMMUNICATION DEVICE SERVICE USAGE ACTIVITIES
First Named Inventor/Applicant Name:	Gregory G. Raleigh
Customer Number:	21912
Filer:	Michael J. Schallop/Veronica Pula
Filer Authorized By:	Michael J. Schallop
Attorney Docket Number:	RALEP037+
Receipt Date:	28-SEP-2010
Filing Date:	
Time Stamp:	16:13:11
Application Type:	Provisional

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$220
RAM confirmation Number	2863
Deposit Account	500685
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 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	Provisional Cover Sheet (SB16)	RALEP037plus_Provisional_Coversheet_Efile.pdf	1000086	no	3
			d1392f912ed05df5e6cd4596005f5ce51d23340b		
Warnings:					
Information:					
2		RALEP037plus_App.pdf	212491	yes	51
			01913da2deca7fb771c11ed8b45c0b4d5d33a1d		
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Transmittal of New Application		1	1	
	Specification		2	47	
	Claims		48	50	
	Abstract		51	51	
Warnings:					
Information:					
3	Drawings-only black and white line drawings	RALEP037plus_Figures.pdf	1287006	no	30
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Information:					
4	Fee Worksheet (PTO-875)	fee-info.pdf	29625	no	2
			1bc3c0c4a152657b969eaeab48fc0e308b93aa043		
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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.

Provisional Application for Patent Cover Sheet

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c)

Inventor(s)

Inventor 1

Remove

Given Name	Middle Name	Family Name	City	State	Country i
Gregory	G.	Raleigh	Woodside	CA	US

All Inventors Must Be Listed – Additional Inventor Information blocks may be generated within this form by selecting the **Add** button.**Add****Title of Invention**

ENTERPRISE AND CONSUMER BILLING ALLOCATION FOR WIRELESS COMMUNICATION DEVICE SERVICE USAGE ACTIVITIES

Attorney Docket Number (if applicable)

RALEP037+

Correspondence Address

Direct all correspondence to (select one):

☒ The address corresponding to Customer Number ☐ Firm or Individual Name

Customer Number

21912

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☒ No.☐ Yes, the name of the U.S. Government agency and the Government contract number are:

Entity Status

Applicant claims small entity status under 37 CFR 1.27

- ☐ Yes, applicant qualifies for small entity status under 37 CFR 1.27
- ☒ No

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Signature

Please see 37 CFR 1.4(d) for the form of the signature.

Signature	/Michael J. Schallop/			Date (YYYY-MM-DD)	2010-09-28
First Name	Michael J.	Last Name	Schallop	Registration Number (If appropriate)	44319

This collection of information is required by 37 CFR 1.51. 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 8 hours 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. **This form can only be used when in conjunction with EFS-Web. If this form is mailed to the USPTO, it may cause delays in handling the provisional application.**

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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.
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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.
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