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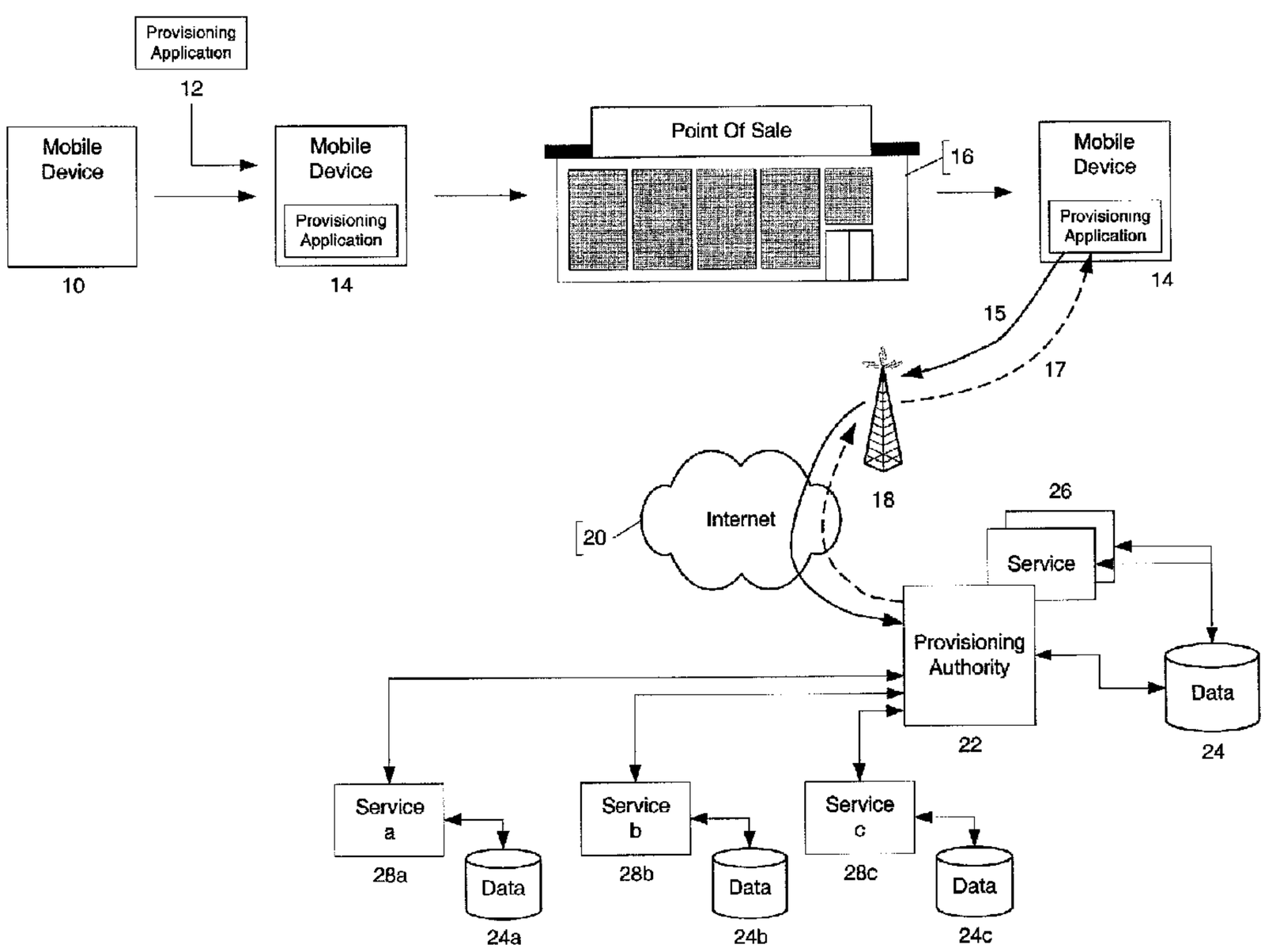
(54) Title: SYSTEM AND METHOD FOR REAL TIME SELF-PROVISIONING FOR A MOBILE COMMUNICATION DEVICE



(57) Abrégé/Abstract:
A system and method for provisioning services for a mobile communication device are disclosed. A provisioning request including provisioning information and specifying a provisioning operation and a first communication service is prepared on the device and sent to a provisioning system. Processing of the provisioning request is dependent upon whether or not a second communication service has been activated for the device. If the device is outside a coverage area of a wireless communication network when a provisioning request is prepared, the request is stored at the device and sent to the provisioning system when the device enters the coverage area. The provisioning system preferably manages service provisioning for multiple services, any of which may be hosted by different service providers.

ABSTRACT OF THE DISCLOSURE

A system and method for provisioning services for a mobile communication device are disclosed. A provisioning request including provisioning information and specifying a provisioning operation and a first communication service is prepared on the device and sent to a provisioning system. Processing of the provisioning request is dependent upon whether or not a second communication service has been activated for the device. If the device is outside a coverage area of a wireless communication network when a provisioning request is prepared, the request is stored at the device and sent to the provisioning system when the device enters the coverage area. The provisioning system preferably manages service provisioning for multiple services, any of which may be hosted by different service providers.

SYSTEM AND METHOD FOR REAL TIME SELF-PROVISIONING FOR A MOBILE COMMUNICATION DEVICE

FIELD OF INVENTION

This invention relates to provisioning of services for a mobile communications device.

DESCRIPTION OF PRIOR ART

When a user purchases a mobile communication device, the device normally cannot operate on a communication network until the device has been activated on the network.

Traditional systems and methods of activating mobile communications device involve the use of an activation code, which is obtained by the user from a network operator or service provider. In order to activate the mobile communications device, the user must typically first communicate a unique mobile communication device number to the network operator via an alternate form of communication. This initial communication is usually telephone-based, but may instead be accomplished through email or a different network such as the World Wide Web or internet.

In the case of telephone-based activation, the user must provide the network operator with activation information by voice over a telephone, which is an immensely error-prone and time-consuming means of activation. The

activation information varies with particular mobile communication devices and networks, but usually includes at least the unique mobile communication device number and often also includes user billing and charging information. Some automated telephone-based systems use touch tones to allow the user to enter the activation information using a telephone keypad, but this is also an extremely error-prone and time-consuming means of activation.

These difficulties are compounded by the often lengthy delay in activation, which may involve a further return call by the network operator to the user at a telephone number specified by the user to provide an activation code to the user. As those skilled in the art will appreciate, activation codes and the task of entering such a code into a communication device vary significantly between different devices, networks and service providers. A user may therefore require further guidance from a network operator to properly enter the activation code manually into the device.

Some communication device vendors and service providers attempt to alleviate the above problems by having a sales person activate a new device at the point of sale. Although the activation is performed for the user by another person, the user must normally wait while the activation is completed in order to provide required personal and billing information. Thus, whether the actual activation process is performed by the user or by a person acting on behalf of the user, device activation remains a time consuming process for the user.

The preceding description relates primarily to initial activation of a communication device. It should be appreciated that similar problems and delays

will be experienced by a user each time the user wishes to add, remove or modify any device-related services offered by a network operator.

There remains a need for a system and method of activating a mobile communication device essentially "right out of the box", by which a user can activate the mobile communication device without a complicated or time-consuming activation scheme.

There remains a further more general need for a system and method which allows a user to manage device services directly on a mobile communication device.

SUMMARY

It is an object of the invention to provide a system and method of activating a mobile communication device by which a user can activate the mobile communication device using only the communication device itself.

It is a further object of the invention to provide a system and method for real-time self-provisioning of services on a mobile communication device.

According to an aspect of the invention, a system and method are provided to allow a user to manage mobile communication device services in real time using the device.

In a preferred embodiment of the invention, when a user first turns on a mobile communication device, the device itself is used to collect relevant information from the user, thereby completing a user profile. This user profile is

preferably stored on the device and includes the user information, the unique mobile communications device number and any other required information.

In the case of initial activation, when the user profile is complete, an application on the device sends the user profile in a provisioning request to a provisioning authority using a temporary provisioning network activation code. Soon after the provisioning authority receives a provisioning request sent from a mobile communication device, the mobile communication device receives a provisioning response sent in real time by the provisioning authority. Upon receiving the provisioning response, the mobile communication device acts on the information obtained in the response. In the above example of initial activation, the provisioning response includes a network activation code that is utilized by the mobile communication device in order to activate the device on the network in real time.

A method for provisioning services for a mobile communication device according to an aspect of the invention comprises the steps of receiving a provisioning request, the provisioning request including provisioning information and specifying a provisioning operation and a first communication service, determining whether or not a second communication service has been activated for the device, if the second service has been activated for the device, then processing the provisioning information to determine whether or not the provisioning operation may be performed, performing the provisioning operation for the first communication service if it is determined in the processing step that the provisioning operation may be performed, preparing a provisioning response

indicating the result of the processing, and sending the provisioning response to the device.

According to a further aspect of the invention, a method for provisioning multiple services for a mobile communication device, comprises the steps of receiving a provisioning request, the provisioning request including provisioning information and specifying a provisioning operation, a base communication service and a related communication service, processing the provisioning information to determine whether or not the provisioning operation may be performed for the base service, if it is determined that the provisioning operation may be performed for the base service, then performing the provisioning operation for the base service, processing the provisioning information to determine whether or not the provisioning operation may be performed for the related service, performing the provisioning operation for the related service if it is determined that the provisioning operation may be performed for the related service, preparing a provisioning response indicating that the provisioning operation was successful, and sending the provisioning response to the device.

In another aspect of the invention, a method for provisioning communication services using a mobile communication device configured to operate within a wireless communication network comprises the steps of preparing a provisioning request at the device, if the device is within a coverage area of the wireless communication network, transmitting the provisioning request to a provisioning authority, and, if the device is outside the coverage area of the wireless communication network, storing the provisioning request at the

device, and transmitting the provisioning request to a provisioning authority when the device enters the coverage area.

A service provisioning system for a mobile communication system according to a still further aspect of the invention comprises means for receiving a provisioning request, the provisioning request including provisioning information and specifying a provisioning operation and a first communication service, means for determining whether or not a second communication service has been activated for the device, first means for processing the provisioning information, responsive to the means for determining, to determine whether or not the provisioning operation may be performed, and first means for performing the provisioning operation for the first communication service if it is determined by the means for processing that the provisioning operation may be performed, wherein the provisioning operation for the first communication service is dependent upon activation of the second communication service.

In another aspect of the invention, a mobile communication device configured to operate within a wireless communication network comprises means for preparing a provisioning request, means for storing the provisioning request, and means for transmitting the provisioning request to a provisioning authority when the device enters a coverage area of the wireless communication network.

A provisioning authority system for managing service provisioning for mobile communication devices in a wireless communication system comprises at least one interface system, means for receiving a provisioning request, operatively associated with each of the at least one interface systems, means for

extracting provisioning information from the provisioning request, and means for distributing the provisioning information, wherein the means for distributing distributes the provisioning information to one of a plurality of means for processing provisioning information.

In another aspect, there is provided a method of provisioning services for a mobile communication device, comprising the steps of: receiving a provisioning request, the provisioning request including provisioning information and specifying a provisioning operation and a communication service; determining whether a prior communication service has been activated for the mobile communication device; and where the prior communication service has been activated for the mobile communication device, then: processing the provisioning information to determine whether the provisioning operation may be performed; performing the provisioning operation for the communication service where the provisioning operation may be performed; preparing a provisioning response indicating the result of the processing; and sending the provisioning response to the mobile communication device.

In another aspect, there is provided a method of provisioning multiple services for a mobile communication device, comprising the steps of: receiving a provisioning request, the provisioning request including provisioning information and specifying a provisioning operation, a communication service and a prior communication service; processing the provisioning information to determine whether the provisioning operation may be performed for the prior communication service; and where the provisioning operation may be performed for the prior communication service, then: performing the provisioning operation for the prior communication service; processing the provisioning information to determine whether the provisioning operation may be performed for the communication service; performing the provisioning operation for the communication service where the provisioning operation may be performed for the communication service; preparing a provisioning response indicating that the provisioning operation was successful; and sending the provisioning response to the mobile communication device.

In another aspect, there is provided a method for provisioning communication services using a mobile communication device configured to operate within a wireless communication network, comprising the steps of: preparing a provisioning request at the mobile communication device; transmitting the provisioning request to a provisioning authority where the mobile communication device is within a coverage area of the wireless communication network; and where the mobile communication device is outside the coverage area of the wireless communication network, storing the provisioning request at the mobile communication device; transmitting the provisioning request to the provisioning authority when the mobile communication device enters the coverage area; receiving the provisioning request at the provisioning authority; extracting provisioning information from the provisioning request; and processing the provisioning information to determine whether the provisioning request may be granted; wherein the provisioning request is associated with a communication service; and wherein the step of processing the provisioning information comprises the step of determining whether granting the provisioning request affects a prior communication service on the mobile communication device.

In another aspect, there is provided a service provisioning system for a mobile communication device, comprising: means for receiving a provisioning request, the provisioning request including provisioning information and specifying a provisioning operation and a communication service; means for determining whether a prior communication service has been activated for the mobile communication device; means for processing the provisioning information to determine whether the provisioning operation may be performed, where the prior communication service has been activated for the mobile communication device; and means for performing the provisioning operation for the communication service where the provisioning operation may be performed; wherein the provisioning operation for the communication service is dependent upon activation of the prior communication service.

In another aspect, there is provided a mobile communication device configured to operate within a wireless communication network, comprising:

means for preparing a provisioning request; means for storing the provisioning request; and means for transmitting the provisioning request to a provisioning authority when the mobile communication device enters a coverage area of the wireless communication network; wherein the provisioning request includes a provisioning operation and specifies a communication service and a prior communication service for which the provisioning operation is requested, and wherein the provisioning authority determines whether the prior communication service is active before provisioning the communication service.

In another aspect, there is provided a provisioning authority system for managing service provisioning for mobile communication devices in a wireless communication system, comprising: at least one provisioning interface; means for receiving a provisioning request, operatively associated with each of the at least one interface systems, wherein the provisioning request is associated with a communication service; means for extracting provisioning information from the provisioning request; means for distributing the provisioning information, wherein the means for distributing distributes the provisioning information to one of a plurality of means for processing provisioning information; and means for determining whether granting the provisioning request affects a prior communication service on the mobile communication device.

In yet another aspect, there is provided a method of provisioning services comprising a first communication service of a first service provider of a first communication system and a second communication service of a second service provider of a second communication system for a mobile communication device, the method comprising the steps of: receiving at a provisioning authority (22) a

service activation request, for the first communication service; determining whether the second communication service has been activated for the mobile communication device by validating the mobile communication device with the second service provider; and where the second communication service has been activated for the mobile communication device, then: processing the activation information to determine with the first service provider whether the activation operation may be performed; performing the activation operation for the first communication service where the activation operation may be performed; preparing an activation response indicating the result of the activation; and sending the activation response to the mobile communication device; and where the second communication service has not been activated for the mobile communication device, then: aborting the activation operation; preparing an activation response indicating that the activation operation was unsuccessful; and sending the activation response to the mobile communication device.

In another aspect, there is provided a provisioning authority system for managing service activation for mobile communication devices in a wireless communication system, comprising: at least one provisioning interface; means for receiving an activation request, operatively associated with each of the at least one interface systems, wherein the activation request is associated with a first communication service of a first service provider; means for extracting activation information from the activation request; means for distributing the activation information, wherein the means for distributing distributes the activation information to one of a plurality of means for processing activation information; means for determining whether granting the activation request affects a second

communication service of a second service provider of the mobile communication device, wherein if the second communication service has been activated for the mobile communication device, then the means are configured to: process the activation information to determine with the first service provider whether the activation operation may be performed; perform the activation operation for the first communication service where the activation operation may be performed; and wherein if the second communication service has not been activated for the mobile communication device, then the means are configured to: abort the activation operation; means for preparing an activation response indicating the result of the activation request; and means for sending the activation response to the provisioning interface from which the request was received.

Further features of the invention will be described or will become apparent in the course of the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the invention may be more clearly understood, several preferred embodiments thereof will now be described in detail by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a system diagram illustrating self-provisioning in accordance with an embodiment of the invention;

Fig. 2 is a more detailed block diagram of a provisioning system according to the embodiment of Fig. 1;

Fig. 3 is a flow diagram illustrating a provisioning process according to an embodiment of the invention; and

Fig. 4 is a system diagram similar to Fig. 2, illustrating a further embodiment of the invention;

Fig. 5 shows a variation of the provisioning system of Fig. 4;

Fig. 6 shows a system diagram of a provisioning system according to a still further embodiment of the invention;

Fig. 7 is a flow diagram of a provisioning process for a service which is related to a further service;

Fig. 8 shows a variation of the provisioning process of Fig. 7, in which both a service and a related service are to be added;

Figs. 9a-9c illustrate a further variation of the provisioning processes shown in Figs. 7 and 8;

Fig. 10 is a flow diagram representing a delete service provisioning process;

Fig. 11 shows a modify service provisioning process; and

Fig. 12 is a block diagram of a mobile communication device for which service provisioning in accordance with various aspects of the invention may be performed.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Provisioning is a general term that is commonly used in the field of mobile communications in reference to the process by which services provided by a service provider are managed. Initial service provisioning, whereby a mobile communication device is first configured for operation within a communication network, is normally termed activation. Having defined these terms, various aspects of the invention will now be described in the context of several illustrative preferred embodiments.

Referring to Fig. 1, after the manufacturing of a mobile communications device 10, a provisioning application 12, which will be described in further detail below, is installed on the device 10. As those skilled in the art will appreciate, installation of the provisioning application 12 may instead be accomplished during the manufacturing process, for example by storing the provisioning application 12 into a read only memory (ROM) or other non-volatile store which is installed into the device 10 and accessible by a processor (not shown) in the device 10. In a particularly preferred embodiment, the provisioning application 12 is provided by a manufacturer of the device 10, although it is contemplated that the provisioning application 12 may instead be provided by a network operator of a communication network in which device 10 is intended to operate or by a further external service provider or application developer.

The manufacturing and provisioning application installation procedures could be adapted to accommodate any such provisioning application supply arrangement. Where the provisioning application 12 is designed by the device manufacturer, according to a preferred embodiment of the invention, the application would preferably be installed during manufacturing. If a network operator or external developer supplies the provisioning application 12, then the application could be either supplied to the device manufacturer for installation during device manufacturing or loaded to the device after manufacturing. Although the physical device 10 would not be substantially changed by the installation of the provisioning application 12, a device on which the provisioning application has been installed is labelled as 14 in Fig. 1. The device 10 may be

an otherwise fully operational communication device, but would require activation and provisioning in accordance with a known process such as one of those described above.

Since the information required for activation and further service provisioning will be different for different services, network operators and other service providers, the provisioning application 12 may be adapted for the network on which the mobile communications device 14 will operate. The provisioning application 12 may also be customized for different network protocols and billing schemes. These and other design criteria of the provisioning application 12 will be described in further detail below.

When a mobile device 14 is purchased at a point of sale 16, the provisioning application may be invoked. The provisioning application preferably reads any available information that may be required for service provisioning, such as a device identification code or number for example, from the device. The user will then preferably be prompted for any further required information and a provisioning request 15 will be transmitted from the device 14, through a mobile communication network 18 in which the device 14 is designed to operate and possibly through a further network such as the internet 20 to a provisioning authority 22. The provisioning authority 22 may store the information provided in the provisioning request 15 to a data store 24 and processes the provisioning request 15. A provisioning response 17 is then generated by the provisioning authority 22 and returned to the device 14. The provisioning response 17 preferably indicates whether or not access to any services specified in the

provisioning request 15 has been granted or denied and provides any further information as may be required by the device 14 to make use of such services. In accordance with an aspect of the invention, an initial provisioning request 15 and response 17 exchange activates a new device on a network. A further aspect of the invention provides for execution of the provisioning application to allow a user to manage and customize device services.

As described briefly above, the provisioning application 12 may be supplied by an external source such as a network operator or service provider or by the device manufacturer. When the provisioning application 12 is a custom application from a service provider, the provisioning authority 22 will normally be associated with a particular service or group of services 26. The provisioning authority may also or instead perform provisioning functions for services such as 28a-28c. Therefore, the provisioning authority 22 may manage service provisioning for either the services 26 provided by the owner or operator of the provisioning authority 22, services 28a-28c provided by other service providers, or both. Where the provisioning authority 22 manages provisioning of external services as 28a-28c, the provisioning authority or operator may also be considered a provisioning service provider, in that the owner or operator is providing the service of provisioning external services. Such a provisioning authority 22 allows a service provider to make a service such as 28a-28c available to mobile communication devices 14 without having to implement a provisioning system, thereby significantly reducing costs to the provider while simplifying provisioning of the service by a user of device 14.

An illustrative example provisioning system is shown in further detail in Fig. 2. As described above, the provisioning application and the device 14 may be invoked by a user to initially activate the device on a communication network 18. An initial provisioning (activation) request 15 is sent from the device 14 to a provisioning authority 22 with which the provisioning application is designed to operate. For the purpose of illustration, the service 28a is assumed to be a network operator or carrier service, external to the provisioning authority 22. The provisioning application 14 and the provisioning authority 22 are preferably configured to obtain from a user and the device 14 all information required by the carrier providing network services 28a. The provisioning authority 22 is further configured to provide such information to the carrier service 28a in a predetermined format compatible with processing arrangements in the service system 28a.

For example, the carrier service 28a may transmit to the provisioning authority 22 a message indicating the required information, including for example user name, mobile device identification number, method of payment for services, credit card number and the like. Most preferably, the provisioning application developer will be aware of at least the information required by the network operator for activation of the device 14 and therefore either retrieves available information within the device 14 or prompts the user to input such information before a provisioning request 15 is sent to the provisioning authority 22. These details relating to required provisioning information may be stored for example in a service provider profile at the provisioning authority 22 and managed by each

service provider. The provisioning authority 22 can then provide all required activation information to the carrier service 28a for processing if necessary and storage in its associated data store 24a. This will ensure that the device 14 can be activated quickly via a single provisioning request 15.

From time to time, in response to changing conditions or in order to provide enhanced services for example, a carrier may determine that further information must be provided before a device 14 may be activated on the carrier's network. A provisioning application may then be updated accordingly for installation in new devices. However, if a user purchases a device 14 in which an older version of the provisioning application 12 had been installed, the carrier may deny access to the network since not all of the required information will be supplied in the initial provisioning request. In such a situation, it is contemplated that the information extracted from the provisioning request 15 may be sent by the provisioning authority 22 to the carrier service system 28a (indicated by a short solid arrow in Fig. 2), which determines that the information is not sufficient for activation of the device 14 on the associated network 18. The carrier service 28a may then transmit a further information request (shown as a short dotted arrow in Fig. 2) back to the provisioning authority 22, which preferably provides for some form of communication with the provisioning application 12 beyond simply responding to provisioning requests 15. The provisioning application then either prompts the user for the additional required information or simply retrieves the information if stored on the device 14 and transmits the information to the provisioning authority 22. Any further information received from the device 14

would be forwarded to the carrier service 28a, which may then activate the device 14 on its network 18 and send a service approval indication to the provisioning authority 22, which then preferably sends a provisioning response 17 to the device 14 to complete the activation process. The device 14 may then be used for communications over the network 18.

Alternatively, when the provisioning application is updated to include further information in the provisioning request as described briefly above, the updated application may be sent to all devices that currently use an older version of the provisioning application. Since the updated version of the provisioning application is distributed to all devices in a network, any subsequent provisioning requests should include all required information, thereby avoiding additional information requests for the further information. The provisioning authority 22 might instead perform a check to determine if a provisioning application should be updated, by checking a provisioning application version number which may be included in a provisioning request for example, the first time a device contacts the provisioning authority 22 after a service provider has changed its information requirements. In the event of a positive determination, an updated provisioning application may be sent to the device over the air. Any devices using the provisioning authority 22 will thereby eventually be provided with the updated provisioning application.

The system shown in Fig. 2 includes further functional blocks such as a billing system 30 and warranty system 32. Although these further systems do not provide communication services, some of the information collected from a mobile

device and a user thereof may be pertinent to such systems. For example, a billing system might be used to keep track of airtime used for provisioning services. A service provider may then be billed for such airtime as a cost of provisioning services provided by the provisioning authority 22. For a warranty system 32, a device identification number, user name and date of activation may be provided by the provisioning authority 22. Thus, where different systems are connected to the provisioning authority 22, the provisioning authority 22 may be configured to provide different information to each system. These types of systems may also or instead be part of the service provider systems 28, with any pertinent information being supplied to such systems by the respective service provider. A further advantage of the single provisioning authority 22 is that additional systems may be added as required and supplied with required data from the provisioning authority 22.

An overall service provisioning process in accordance with an aspect of the invention is shown in the flowchart of Fig. 3. As described above, a provisioning application 12 is installed in a mobile communication device 10 during or after manufacturing (S302). At some time later, after the device 14 is purchased and first powered on (S304), the provisioning application may be invoked at a step S306. Although shown in Fig. 3 as two distinct steps S304 and S306, it is contemplated that powering on the device 14 may automatically invoke the provisioning application. Alternatively, the provisioning application may be invoked following a different predetermined event, such as when a power source in the device 14 has been charged to a specified level or when the device

14 first enters network coverage after being powered on for example. The provisioning application might also require that the user manually enter a code or function call to begin a device activation or service provisioning process.

When the provisioning application has been invoked, provisioning information such as user name, a device identification number, a service plan selection and the like, which may be specified in a service provider profile at the provisioning authority 22, is obtained from the user and/or from a storage location in a device memory component, as indicated at step S308. In step S310, a provisioning request is prepared and sent to the provisioning authority 22. If the device is out of mobile communication network coverage or is otherwise unable to communicate over the network when the provisioning request is prepared, the request is preferably stored on the device and sent to the provisioning authority, either automatically or responsive to a user input, when the device is able to communicate over the network, such as upon re-entry into network coverage.

The provisioning authority 22 extracts the provisioning information from a received request and may also store the extracted information to local data store such as 24 (S312). Where the provisioning authority 22 manages external services for other service providers, the storage of provisioning information may be temporary, such that information records for clients of external service providers are not maintained after an activation or provisioning process is completed. Sensitive provisioning information such as credit card numbers or other billing details might also be encrypted by the device 14 before the provisioning request is sent. Any encrypted information is then preferably

decrypted only by a provisioning authority "client", such as a service provider 28a-28c or an external system 30 or 32. The provisioning system 22 therefore does not have access to sensitive information relating to users that subscribe only to external services not operated by the provisioning authority 22. If any external systems such as the billing system 30 and warranty system 32 require any of the extracted information, such information will be forwarded to the external systems, at step S314.

In step 316, the provisioning authority determines if the provisioning request relates to a service 26, if any, provided by the provisioning authority 22. Where the requested service is provided by the provisioning authority operator, the provisioning authority 22 determines whether or not all of the required information has been received (S318). If all required provisioning information, which may be different for different services, has been received, then a determination is made at step S320 as to whether or not the user or device should be granted access to the requested service. Service may be denied for example if invalid billing information an invalid device identification number has been provided. The provisioning server 22, or a service provider administration system, might check to ensure that a credit card number does not correspond to a stolen credit card or that a device identification number does not already exist in its client records. Other criteria for denial of service will be apparent to those skilled in the art and are considered to be within the scope of the invention.

When a provisioning request is approved, the device and user are registered for the requested service (S322). Where the requested service is

network communication service, step S322 involves activation of the device on the network. In this description, the more general term "register" is intended to include any add service operations. As will become apparent below, adding network communication service is referred to as "activation". Thus, although registration may include activation of a device on a network, activation hereinafter refers specifically to adding network communication service.

Referring again to Fig. 7, a provisioning response is then prepared (S324) and sent back to the device (S326). If the device requires any further information in order to make use of an approved service, such information is preferably included in the provisioning response. The device is preferably configured to update an available services list or menu (S328) when a requested service has been successfully provisioned. If the requested service is denied at step S320, an appropriate provisioning response is prepared (S324) and returned (S326) to the device. The device may then update (S328) a record of services for which a provisioning request has been denied, possibly including the reason for denial of service. The user is then able to determine whether or not a further provisioning request for the same service should be submitted at a later time. The provisioning process then ends at step S330. After initial provisioning or activation, a user may invoke the provisioning application at any time to manage the services installed on the device 14.

Returning now to step S318, if not all required provisioning information has been submitted, for example if a carrier has changed the information that is required for activation as described above, the provisioning authority is preferably

configured to request any additional required information from the device 14 or user, at step S332. When a response to the request for additional information is received from the device 14 (S334), the information is extracted (S312) and distributed to any external systems (S314) if necessary. The process then continues at step S318 and proceeds as described above. Although not specifically shown in Fig. 3, it will be apparent that additional required information may similarly be requested by a system such as the billing system 30 or warranty system 32. System information requests may be distinct from service provider information requests, but some form of information request coordination is preferred in order to avoid multiple requests for the same information. When the provisioning application is kept current as described above, the provisioning request will normally include all required information and further information requests to the device should therefore be minimal.

It may also be preferable to limit the number of times additional required information is requested. After a certain number of requests have been made for the same information, the provisioning process may proceed from step S318 to step S320, to determine whether or not access to the requested service should be granted without the missing required information. If access to the service is granted, the device is registered for the service at step S322 and the process proceeds as described above. This granting of service might instead be a restricted or time limited access, such that a provider may require that a user provide the missing information within a certain time period in order to maintain the service or to obtain access to certain aspects of a service. If the service is

denied at step S320, then a provisioning response is prepared at step S324, indicating that some required provisioning information was not supplied and could not be obtained, and sent to the device. Other arrangements intended to limit the amount of time or provisioning system resources engaged in repeated information requests may also be implemented at the provisioning authority 22 or a system or service provider which may request such additional information. For example, the provisioning authority 22 may cancel an outstanding additional information request, prepare and forward an appropriate provisioning response or message to the device and send a message to the system or service provider to indicate that the requested additional information could not be obtained if no response to the information request has been received within a predetermined maximum response time interval.

If the service requested in the provisioning request is provided by an external provider (S316), such as the carrier service 28a for initial device activation, then the extracted provisioning information is sent to the provider at step S336. At step S338, the provider determines whether or not all required provisioning information has been received and if not, additional information is requested via the provisioning authority 22 as described above (S332, S334). If the provisioning authority 22 stores service provider profiles, this check may instead be performed by the provisioning authority 22. When all required information is received, access to the service is either denied or approved (S340) and, if approved, the device is registered for the service (S342). Step S340 may also be executed when additional information has been requested a

predetermined number of times without success or an information request has timed out at the provisioning authority 22, as described above. The external service provider then returns to the provisioning authority an indication of that the service request has been approved or denied, and the provisioning authority then prepares (S324) and returns (S326) a provisioning response to the device 14. Based on the provisioning response, the device 14 may update lists of available and unavailable services (S328).

The preceding discussion relates primarily to initial provisioning or activation of a device 14 on a network 18. According to a further aspect of the invention however, the provisioning application in device 14 may be executed by a user to manage the services to which he or she subscribes. After the device 14 has been activated, further provisioning requests 14 may be sent to the provisioning authority 22. These further provisioning requests may add, remove or modify device services for example, and may relate to any services 26, 28a, 28b or 28c for which provisioning is accomplished through the provisioning authority 22. The provisioning process for such further provisioning requests proceeds substantially as described above.

The systems shown in Figs. 1 and 2 provide for provisioning of services for a device 14 using only the device 14 itself. In some circumstances however, a user may wish to provision services through an alternative interface. For example, a user may wish to activate a device 14 or perform other provisioning services when the device is outside wireless network coverage. The user might also feel more comfortable using an interface with which he or she is more

familiar than a newly-purchased device 14. Fig. 4 shows such a provisioning system providing not only the self-provisioning functionality as described above, but also web-based and telephone-based provisioning. In the Fig. 4 system, a secure web page 44 is provided to allow a user to manage device services through an internet-connected computer 42. Although computer 42 is shown as a desktop computer in Fig. 4, it will be apparent that computer 42 may instead be a portable computer such as a laptop or palmtop computer. The connection of the computer 42 to the web page 44 will commonly be a wired connection through an internet service provider (ISP, not shown), although other connection schemes, such as through a wireless modem and a wireless network, are also contemplated.

When a connection to the secure web page 44 has been established, provisioning information required by the provisioning authority 22 and/or any service providers 26, 28a, 28b, 28c offering a requested service would be entered into the computer 42 for transfer to the provisioning authority 22. In accordance with a further aspect of the invention, the mobile device 14 may be connected to the computer 42, through a serial connector for example, so that device information such as a device identification number is transferred directly from the device 14 to the computer 42, thereby reducing the amount of information that must be entered by the user. The provisioning process proceeds substantially as described above in conjunction with Fig. 3, except that provisioning requests and responses are exchanged between the provisioning

authority 22 and the computer 42 instead of between the provisioning authority 22 and the device 14.

Upon completion of a provisioning process, the device 14 must be informed of the approval or denial of the provisioning request. It is therefore contemplated that the provisioning response will be sent to both the computer 42 and the device 14, provided that the device is within network coverage. The provisioning response might instead be sent to the device over a connection to computer 42, if available. Otherwise, the provisioning application on the device 14 may include a utility or function to send a "complete provisioning" or like request to the provisioning authority 22 when the device enters network coverage, in response to which the provisioning authority 22 preferably then sends to the device 14 the provisioning response and any information required for the device 14 to use an approved service. When a shared computer 42 is used in the provisioning process however, the user may prefer to have the provisioning response sent only to the device 14 or perhaps to an alternate address. Such an alternate address may for example be specified in the provisioning request.

For telephone-based provisioning, a user contacts the provisioning authority 22 through a telephone system 46. Although it is preferred that such conventional provisioning interfaces as a telephone system are avoided by using the device 14 and a provisioning application installed on the device to carry out provisioning operations, telephone-based provisioning may be supported by a provisioning authority in order to provide a familiar interface for new users, as

described above. The telephone-based provisioning scheme does not involve a request and response mechanism, but instead involves interaction with an automated telephone system (not shown) or a service provider telephone operator or other customer service personnel that may handle service provisioning for the user through a provisioning authority user interface (UI) (not shown). However, even if a user chooses telephone-based provisioning, some type of provisioning response must be prepared by the provisioning authority 22 and sent to the device 14 to indicate whether or not a service has been approved and to enable the device to use the service. If the device is within network coverage, the provisioning response may be sent to the device upon completion of a provisioning process. The provisioning response would otherwise be sent to the device when a "complete provisioning" or like request is received by the provisioning authority 22 when the device enters network coverage.

For a service provider, a provisioning system such as shown in Fig. 4 has the advantage that only a single provisioning application or interface must be implemented. The provisioning authority 22 would preferably make appropriate application programming interfaces (APIs) available to any service provider that intends to effectively offload provisioning functions to the provisioning authority 22 instead of implementing a custom provisioning system. The APIs define information formats, function calls and the like that a service provider would need to support in order to communicate with and interpret information received from the provisioning authority 22. In the system of Fig. 4, the provisioning authority 22 provides potential clients of any of its associated service providers with a choice

of device-based, web-based or telephone-based provisioning, while the service providers need support only a single interface to the provisioning authority 22. Thus, a service provider allows provisioning of its services via a device 14 with a provisioning application, while also providing for more traditional provisioning schemes where a user of a device 14 chooses to use a traditional provisioning scheme or a device for which services are being provisioned is not capable of self-provisioning, i.e. no provisioning application has been installed on the device.

A further advantage of a system as shown in Fig. 4, incorporating a provisioning authority 22 that supports multiple provisioning schemes, is that a user is not restricted to any particular provisioning scheme. For example, a new user may not feel comfortable using a new device 14 to provision device services and may instead use the secure web page 44 or telephone system 46 for activation and any other initial service provisioning. When the user has become more familiar with the device however, the user may wish to provision new services or manage existing services using the provisioning application on the device 14. Since all of these interfaces are supported by the single provisioning authority 22, the user may perform provisioning functions via any one of the interfaces at any time.

As those skilled in the art will appreciate, the activation of a communication device on a communication network using the device itself can be problematic in that network operators may be reluctant to allow a device to access the network prior to activation of the device on the network. Without

network access, the device cannot communicate with a provisioning system such as the provisioning authority 22. One possible solution to this problem is to activate each device on the network within which it is intended to operate, before the device reaches the point of sale 16 (Fig. 1). For example, a device might be activated before it leaves a manufacturing plant or when the provisioning application 12 is installed. Where network operators charge for services immediately after a device is activated however, this activation of the device prior to sale incurs costs which must either be absorbed by the device manufacturer, the vendor of the device or the service provider, or passed on to the consumer, neither of which may be desirable.

The provisioning system of Fig. 4 provides a more feasible solution to this network access problem in that a device 14 may be activated through one of the alternate provisioning interfaces such as the web page 44 or telephone system 46. After the device 14 has been activated, provisioning requests and corresponding responses may be sent and received by the device 14. Any subsequent service management functions can then be performed using the device 14 and its resident provisioning application.

In a particularly preferred embodiment, the provisioning application is the only application that may access communication resources on a device 14 before the device is activated on a network. All other communication-related applications are initially restricted from performing any network communications functions. If a messaging application is installed on the device for example, a user may be able to compose and store a message, but until the device is

activated on the network, no such message can be transmitted over the network. Applications not requiring network resources, such as calendar applications, calculators, word processors, information synchronization applications which provide for synchronization of device records with records on a user's PC, games, short-range communications applications and the like may be fully operational, but only the provisioning application is permitted to send and receive via the network.

This restriction on initial communications functionality effectively provides a communication device that, until properly activated on a network, may call only a provisioning system such as the provisioning authority 22 or perform any other legally required operations, such as placing 911 emergency calls where the device is a General Packet Radio Service (GPRS) communication device. As such, a network operator need not be concerned that allowing the device to access the network will provide free network service. Since only the provisioning application and other legally required applications and operations are able to send and receive on the network, only provisioning functions and legally required functions may be performed. According to this embodiment, only the costs associated with the actual activation transaction must be covered by the manufacturer, vendor or carrier or passed on to the user. The user may activate a device using an alternate system such as web page 44 or telephone system 46, if available, and thereby avoid any airtime charges associated with the activation transaction. Upon receipt of a provisioning response, regardless of the

provisioning scheme used for device activation, any other communication-related functions and applications on the device would preferably be enabled.

Initial communications operations restriction as described above is controlled by the device itself. Such communications restrictions may instead be imposed at the network level or at a service provider level. For example, a network operator or service provider may be configured to detect that a device has not been activated on a communication network or properly registered for communication services. Any communication operation between the device and any other destination than the provisioning authority 22 will preferably be rejected until the device is activated on the network and possibly registered for a particular service, unless support for other communication functions is required by law, as in the above example of 911 calls.

In a GPRS network for example, a subscriber identity module or SIM card in a communication device must be populated before the device is fully functional on the network. As those skilled in the art will appreciate, a device must also establish a packet data protocol (PDP) context prior to communicating over the network. According to an aspect of the invention, a network operator can easily determine, from this PDP context, that the device is not yet activated on the network and thus can only communicate with a provisioning authority such as 22. The network operator may then allow the device to send a provisioning request to the provisioning authority in order to activate the device for network service. The information required by the SIM card will then preferably be provided in the provisioning response. The provisioned network communication functions are

thereafter fully operational on the device. Alternatively, a GPRS network operator or service provider may determine the status of a device by accessing a home location register (HLR) or possibly a visitor location register (VLR) in the network.

It is apparent from the description above that different provisioning schemes may be preferred or required for different devices and different networks. In accordance with a further aspect of the present invention shown in Fig. 5, a single provisioning authority 50 manages service provisioning for multiple networks 52, 54 and devices 14a, 14b. In Fig. 5, service a (28a) includes network communication services provided by network 52 operator and service b (28b) includes network 54 communication services provided by an operator of network 54.

The provisioning authority 50 is preferably substantially the same as provisioning authority 22 in Figs. 1, 2 and 4, but is capable of communication over more than one wireless network. Such multiple-network communication functionality may be facilitated by different communication modules in the provisioning authority 50, but is preferably provided in the gateways (not shown) through which the wireless networks 52 and 54 connect with the internet 20. The provisioning authority 50 preferably communicates with the gateways over the internet using transmission control protocol over internet protocol (TCP/IP). The gateways then perform any required information format and protocol conversions to enable communication with the devices 14a and 14b over the respective networks 52 and 54. These gateways may instead be incorporated into a single gateway which implements an IP interface for communication over the internet

20 and wireless network interfaces for communication with devices over the networks 52 and 54. For example, the provisioning authority 50 may communicate with a wireless gateway such as described in the co-pending United States Patent Application Serial No. 60/257425, titled "System And Method For Routing Information To A Mobile Communication Device Through A Wireless Communication Network", and filed on Dec. 22, 2000, using a TCP/IP-based protocol such as the proprietary service routing protocol (SRP) described therein.

The devices 14a and 14b may be either similar devices adapted for operation on the different networks 52 and 54 or entirely different devices. However, it is preferred that a provisioning application is resident on at least one of the devices 14a, 14b. For the sole purpose of illustration, it is assumed that the operator of network 52 requires that a device 14a be activated before any network communications will be permitted, whereas the operator of network 54 allows a new device 14b with restricted initial communications functionality as described above to communicate with the provisioning authority 50 to perform initial service provisioning.

A user of a new device 14a intended to operate on the network 52 must therefore initially provision network services from the network operator 28a through the secure web page 44, telephone system 46 or another alternate provisioning interface (not shown) as may be provided. Once the device 14a is activated on the network 52, the provisioning application, if installed, may be executed to perform further provisioning functions using only the device 14a.

Although an alternate provisioning interface must be used for initial provisioning or activation of the device 14a on the network 52, a user of device 14b may use the provisioning application and the device 14b itself to accomplish device activation through the provisioning authority 50. As will be apparent, any alternate provisioning interface may instead be used when desired or required, such as when the device 14b is out of network coverage for example. A user of device 14b has a choice of self-provisioning or alternate provisioning for initial activation of the device 14b.

A single provisioning authority may thereby independently manage provisioning functions for multiple devices, networks and service providers. Any provisioning scheme restrictions related to one device, network, or service provider associated with the provisioning authority 50 have no effect on provisioning functions of other devices, networks or service providers associated with the same provisioning authority.

A provisioning system in accordance with a further embodiment of the invention is shown in Fig. 6. The system of Fig. 6 is substantially the same as the system shown in Fig. 4 and operates substantially as described above, but includes a service provider 28d, which communicates with the provisioning authority 50 via the internet 20 or other wide area network 20. Information and requests are exchanged between the service provider system 28d and the provisioning server 50, as described above, through the wide area network 20. Other communication schemes and arrangements providing for communications between the provisioning authority 50 and a service provider system 28 will be

apparent to those skilled in the art. Although the particular form of communications between the provisioning authority and associated service providers may vary, the overall provisioning scheme is preferably substantially as described above.

It should also be apparent from Fig. 6 that a provisioning authority 50 may support more than one type of communication interface to different service providers. In the example system of Fig. 6, the internal services 26 may use an internal interface and protocol for communications with the provisioning authority 50, service provider systems 28a, 28b and 28c may be associated with local service providers in the vicinity of the provisioning authority 50 and be configured for communication with the provisioning authority 50 via a specific local interface or protocol, whereas a remote service provider system 28d is configured for a further communications interface and protocol. Those skilled in the art will appreciate that many different combinations of authority to service provider interfaces, including still further interfaces not shown in Fig. 6, may be possible in accordance with this aspect of the invention.

As described above, the provisioning authority 50 may exchange different information with different systems. For example, the provisioning authority may provide different information to different service provider systems. In a further extension of this feature, the provisioning authority 50 may exchange information with a particular service provider while executing a provisioning process for a different service provider. This facilitates not only multi-tasking or simultaneous execution of multiple provisioning processes for different independent services

possibly for different users, but also provisioning of related services from different service providers for the same user. Those skilled in the art will be familiar with the concept of multi-tasking. The latter related-service provisioning scheme will be described in further detail below.

This aspect of the invention may be particularly applicable where one service provider offers services related to a service provided by a different service provider. In a particular preferred embodiment, a service provider such as 28d is an ISP that provides at least messaging services, most preferably email services. Another service provider such as 28c which offers some type of enhanced email service, including but in no way limited to redirecting received email messages from its email system to a mobile communication device 14, to users of its own email service may wish to extend its customer base by offering the enhanced service to users of other external email services of such as those provided by service provider 28d. In this embodiment of the invention, the device 14 is a wireless communication device capable of at least sending and receiving email. In order to complete a provisioning process for such an extension of enhanced services, the provisioning authority 50 must communicate with both service provider systems.

In the above example where a service provider 28c offers an email redirection service, a mobile device user may wish to provision the service for an existing email account associated with a different service provider 28d. The user may invoke the provisioning application on the device 14 or contact the provisioning authority 50 through one of the alternate provisioning interfaces

(secure web page 44 or telephone system 46) as described above. The overall provisioning process proceeds substantially as described above and shown in Fig. 3, but involves additional processing between the provisioning authority 50 and the external service provider 28d.

Fig. 7 is a flow diagram representing the additional communications and processing which is performed during a related-service provisioning process. In order to avoid congestion in Fig. 7, only the steps of Fig. 3 that are affected by the additional processing associated with related-service provisioning are shown in Fig. 7. It is to be understood any of the steps shown in Fig. 3 but not shown in Fig. 7 are common operations that will also be performed during related-service and most other provisioning operations.

Referring now in detail to Fig. 7, the steps S702 through S708a, S708b are preferably performed by the provisioning authority 50 during processing of a provisioning request for a service offered by a first service provider that is related to a different service offered by a second service provider. The remaining steps in the provisioning process, including those preceding step S310 but not shown in Fig. 7, are substantially as described above and therefore will be described further only to the extent necessary to illustrate related-service provisioning.

At step S310, a provisioning request is submitted to the provisioning authority. Although it is preferred that the request is prepared and sent on the device 14, it will be understood that any of the alternate provisioning interfaces shown in Fig. 6 may instead be used. The provisioning process then proceeds as described above to extract and store provisioning information (S312), send

pertinent information to such systems as billing and warranty systems (S314) and determine whether or not the first service provider offering the requested service is external to the provisioning authority 50 (S316). The first service provider may then check to ensure that all required information has been received (S318, S338) and requests any missing information if necessary (S332). As described above, device provisioning applications are preferably kept current, such that all required information will normally be provided in a provisioning request.

Depending upon the nature of any missing information, the first service provider may continue to process the request for service, as described above. When the required information has been received, or the first service provider determines that the service request processing should continue without certain information, then an indication to that effect is preferably sent to the provisioning authority 50 at step S702, if the first service provider is an external service provider. Since the enhanced service offered by the first service provider, an email redirection service in the above example, is dependent upon the related service (an email account) offered by the second service provider, then the provisioning authority or first service provider must at least verify that the user submitting the provisioning request for the enhanced service has previously provisioned the related service.

In the illustrative example process shown in Fig. 7, the first service provider attempts to verify the related service before the request for its enhanced service is processed. However, these processes may be performed in a different order, according to the preferences of the particular first and/or second service

provider involved in the related-service provisioning request, or by the provisioning authority as independent processes. For example, the first service provider may wish to verify user billing information or mobile device information before attempting to verify or validate the related service. The second service provider may also establish preliminary checks that must be performed by the first service provider or provisioning authority before a validation request will be processed. These or other checks, including those involved in approving or denying the requested service, may also be performed simultaneously. The first service provider may for example perform some of its associated service approval checks while a related service validation request is pending or outstanding to the second service provider. The particular order and type of checks performed may be determined by the provisioning authority, the first service provider, the second service provider, or some combination thereof. These and similar request processing criteria may also be specified in a service provider profile at the provisioning authority 22.

Related-service validation begins at step S704a or S704b, in which the provisioning authority sends a related-service validation request to the second service provider. The validation request will include such information as may be required by the second service provider to authorize access to its user or service records. This information may include for example a user name or identifier, an account name or number for the related service and likely an authorization code such as a password, and is preferably provided by the user in the related-service provisioning request or in response to further information requests from the first

service provider or the provisioning authority 50. Although not shown in Fig. 7, it is contemplated that the second service provider may be able to request from the user, the provisioning authority or the first service provider any required information that may not have been provided in the validation request. This additional information request may be submitted substantially as described above and illustrated in steps S332 and S334, with the response information being provided to the second service provider.

When a related-service validation response is received at step S706a or S706b, it is determined whether or not the related service was validated by the second service provider (S708a, S708b). This determination is preferably made at the first service provider system when the requested service is provided by an external service provider 28 or by the provisioning authority 50 when the service is provided by an internal service provider 26. If the related service was validated, then processing continues at step S320 or S340, wherein the first service provider determines whether or not access to the requested service should be granted. If the first service provider approves the service request, then the device is registered for service (S322, S342). If the first service provider is an external provider, then an appropriate indication is returned to the provisioning authority (S344). A provisioning response is then prepared and sent to the device or alternative provisioning system that was used to submit the original related-service provisioning request, and the device services are updated accordingly (S328), as described above.

If the second service provider does not validate the related service, then access to the requested service is denied, an appropriate indication is returned to the provisioning authority (S344) if the first service provider is an external service provider, and a provisioning response is prepared and returned to the user (S324, S326). A denial of service by the first service provider is similarly communicated to the user, through an indication to the provisioning authority if necessary and a provisioning response.

The first and second service providers may also provide a conditional service approval or related-service validation. For example, the second service provider may indicate in a validation response that a user account is not in good standing, but may be returned to good standing provided that the user takes some action to restore the account. Access to the requested service may then be granted to the user, conditional upon the user restoring the account to good standing. If the first service provider determines that access to the requested service should be denied, for example where an invalid related-service account number, an incorrect related-service account password, invalid billing information or the like has been provided by the user, full access to the service could be made conditional upon the user supplying correct information and subsequent verification of the information by the first and/or second service provider. In a similar manner, where the second service provider does not validate the related service, the first service provider may submit an additional information request to the user through the provisioning authority to request correct or valid information and submit a new validation request to the second service provider when the

additional information is received. As described above, the number times the first or second service provider requests additional information from the user is preferably limited.

In the above example of an email redirection service offered by the first service provider for existing email accounts provided by the second service provider, registration of a mobile device for redirection services (S322, S342) would involve not only a registration process to register the user's device on the first service provider's system, but also some sort of registration process at the second service provider. In a preferred embodiment of the invention, setup of the user's email account for redirection service is performed in conjunction with the validation by the second service provider. Basic email forwarding information, including at least a forwarding address, associated with the first service provider, to which new messages arriving at the user's email system or indications that new messages have arrived at the user's email system should be sent, may be provided to the second service provider as part of the validation request. The forwarding information may instead be sent to the second service provider when the user's account has been validated (S708a, S708b) or the provisioning request has been approved (S322, S342).

In a particularly preferred embodiment, the provisioning authority sends an encrypted validation request, in the form of an email message encrypted using PGP™ (Pretty Good Privacy™) for example, to the second service provider. This message includes at least an email account identifier and an email account password supplied by the user and email forwarding information for the first

service provider system. A validation response from the second provider then preferably includes not only a validation of the email account information, but also a confirmation that the email forwarding has been successfully enabled. Redirection of email from the first service provider system to the mobile device may then be configured at both the first service provider system and the mobile device.

The provisioning process shown in Fig. 7 assumes that the user wishes to provision a service from a first service provider that is related to an existing service from a second service provider. According to a further aspect of the invention, the enhanced service and the related service may be provisioned via a single provisioning request. Such a process is shown in Fig. 8. As in Fig. 7, some of the common steps in the provisioning process have not been shown in order to avoid congestion in the drawing.

The provisioning request in this embodiment of the invention is substantially the same as the provisioning requests described above, although its information content may differ depending on the services being provisioned. For illustrative purposes, the above example of an email redirection service offered by a first service provider for an email account hosted by a second service provider will be used. Where a new email account is to be provisioned, the user must provide at least a preferred user name and password, and any billing information as may be required by the second service provider.

At step S310, a multiple-service provisioning request is submitted to the provisioning authority. This provisioning request is preferably prepared on and

sent from the device 14 using the provisioning application 12. The provisioning process then proceeds to execute the operations in steps S312 through S316 as described above. The first service provider then checks to ensure that all required information has been received (S318, S338) and requests any missing information if necessary (S332).

When the required information has been received or the first service provider determines that the service request processing should continue without certain information, then an indication to that effect is preferably sent to the provisioning authority 50 at step S802 if the first service provider is an external provider. Where the first service provider is internal to the provisioning authority system, it should be apparent that no such indication need be sent to the provisioning authority.

The provisioning authority may then attempt to provision a new email account from the second service provider before the request for enhanced service is processed. However, as above, these processes may be performed in a different order, according to the preferences of the particular first and/or second service provider, or possibly simultaneously. For example, the first service provider or provisioning authority may first verify user billing information or mobile device information before the service and/or related service are provisioned. The first service provider may instead perform some of its associated service approval checks while a related service provisioning request is outstanding from the provisioning authority. The particular order and type of checks performed

may be determined by the provisioning authority, the first service provider, the second service provider, or some combination thereof.

Related-service provisioning, in this example email account provisioning, is initiated by sending the related-service provisioning request to the second service provider at step S804a or S804b. The related-service provisioning request may be in the form of an encrypted email message to the second service provider as described above and should any information required by the second service provider to process the provisioning request. This information may include for example the preferred user name and password and billing information required by the second service provider, which was provided by the user in the original multiple-service provisioning request. The second service provider is also preferably able to request from the user, the provisioning authority or the first service provider any required information that may not have been provided in the related-service provisioning request, substantially as described above and illustrated in steps S332 and S334, with the response information being provided to the second service provider.

When a related-service provisioning response is received at step S806a or S806b, the first service provider or provisioning authority determines whether or not the related service was successfully provisioned (S808a, S808b). If so, then the first service provider continues its processing at step S320 or S340, to determine whether or not access to the requested service should be granted. If the first service provider approves the service request, then the device is registered for service (S322, S342). If the first service provider is an external

provider, then an appropriate indication is returned to the provisioning authority (S344). A provisioning response is then prepared and sent to the device or alternative provisioning system that was used to submit the original related-service provisioning request, and the device services are updated (S328).

If the second service provider denies the related-service provisioning request, then access to the requested service may be denied, an appropriate indication is returned to the provisioning authority (S344) if the first service provider is an external service provider, and a provisioning response is prepared and returned to the user (S324, S326). A denial of service by the first service provider following successful provisioning of the related service is similarly communicated to the user, through an indication to the provisioning authority if necessary, and a provisioning response. The user is preferably able to specify, either in the original multiple-service provisioning request or a further message sent to the provisioning authority in response to the provisioning response, any actions to be taken if provisioning of only one or the other of the requested service and the related service is successful. For example, the user may wish to maintain a new email account even if the request for redirection service is denied. The user might instead prefer that the new related service be cancelled if access to the requested service is denied.

The first and second service providers may also provide a conditional service approval or related-service validation. For example, the second service provider may indicate in the related-service provisioning response that the preferred user name is already used in its email system or that the preferred

password does not conform to its length or other formatting requirements, such that an email account could not be established. Access to the requested service may then be granted to the user by the first service provider, conditional upon the user establishing an email account and providing any information required by the email account provider to allow email forwarding rules to be configured on the account. When such information is provided by the user, the first service provider need only validate the existing account as described above in conjunction with Fig. 7. Alternatively, in response to such user name or password problems, the first or second service provider may send an additional information request to the user to prompt the user to select and submit a different user name and/or password. The second service provider then preferably re-executes its processing of the related-service provisioning request with the new information from the user. As above, if the provisioning application remains current with any changes in service provider requirements, such properties as password formatting requirements may be checked at the device (or web interface, if used for provisioning) before a provisioning request is submitted.

Where invalid billing information or the like has been provided by the user, full access to one or both of the service and the related service could be made conditional upon the user supplying correct information and subsequent verification of the information by the first and/or second service provider. As described above, the number times the first or second service provider requests additional information from the user is preferably limited.

Although Figs. 7 and 8 show separate provisioning processes, dependent upon whether or not the related service exists or must also be provisioned, a hybrid type of provisioning process, wherein the provisioning authority or first service provider determines whether the related service must be provisioned or merely validated, is also contemplated. Such a hybrid process would include a step to make this determination and proceed to either validate (steps S702 through S708a or S708b) or provision (steps S802 through S808a or S808b) the related service.

Figs. 9a-9c show a further variation of related-service and multiple-service provisioning, including both validation and provisioning steps for the related service, in which a mobile device user has the option of using a related service offered by either the first service provider or a second service provider. Continuing with the above example of an email redirection service and a related email service, in this embodiment of the invention, the first service provider hosts not only the redirection service but also email services. As in Figs. 7 and 8, some of the common steps in the provisioning process have not been shown in order to avoid congestion in the drawing.

A provisioning request is submitted to the provisioning authority at step S310. The provisioning process proceeds to execute the operations in steps S312 through S316 as described above. The first service provider then checks to ensure that all required information has been received (S318, S338) and requests any missing information if necessary (S332).

When the first service provider is an internal service provider associated with the provisioning authority and all required information has been received or the first service provider determines that the service request processing should continue without certain information (S318), then the provisioning process proceeds as shown in Fig. 9b.

At step 902, it is determined whether or not the related service is an existing service, i.e. whether or not the user has an email account with which the email redirection service is to be established. If so, then the first service provider preferably determines whether or not the related service is hosted by a second service provider (S904), for example by checking the domain name associated with the email account information provided by the user. Where the existing service is also hosted by the first service provider, then the first service provider checks the related service information to validate the user's related service at step S906. If it is determined that the related service is provided by a second service provider, then a validation request is sent to the second provider (S908). The internal validation result (S906) or the validation response from the second provider (S909) is then analyzed to determine whether or not the related service was validated by the associated first or second service provider, at step S910.

When the related service is validated, the provisioning process continues at step S320 (Fig. 9a). The user is either approved or denied access to the requested service via steps S320 through S330 substantially as described above.

Although described only briefly above, Fig. 9b shows possible exception or error processing steps which may be executed when an existing related service is not validated. At step S912, the first service provider determines whether or not validation of the existing related service should be re-tried. For example, the provisioning authority, first service provider or second service provider may automatically re-try validation a specific number of times after a first validation failure, or upon other conditions being satisfied. The first or second service provider or the provisioning authority may then request that the user re-enter some or all related-service information (S914) before re-trying the validation. Where a validation response indicates an incorrect related-service password for example, the user may be prompted to re-enter the password.

If the validation fails and will not be re-tried, then the user may be given the option of provisioning a new related service (S916). This allows the user to provision a new email account if the existing account information provided in the provisioning response or during the provisioning process cannot be validated. When the user chooses to provision a new related service, new related-service provisioning information, possibly including a preferred service provider, user name, password, billing information and any further information as may be required by the specified service provider, will be requested from the user (S918). The first service provider then attempts to provision a new email account on behalf of the user, as will be described in further detail below. When related-service validation has failed and will not be re-tried, and the user does not wish to

provision a new related service, processing continues at step S324, as described above.

If the user does not yet subscribe to a related service or has chosen to provision a new related service, the first service provider determines, at step S920, whether or not the requested new related service is hosted by the first service provider or a third service provider. Those skilled in the art will appreciate that when the new related service is being provisioned after a related service validation failure, the third service provider may be the second service provider or a further different service provider. If the requested related service is hosted by a third service provider, then a related-service provisioning request is sent to the third service provider (S922) for processing. A related-service provisioning response is then returned to the provisioning authority or the first service provider, as indicated at step S924. If the requested related service is hosted by the first service provider, the first service provider processes the related service request at step S926. Where both the service and the related service are to be provisioned from the first service provider, the step S926 may instead be incorporated into step S320, such that processing would continue at step S320 following an affirmative determination at step S920.

At step S928, the first service provider or provisioning authority determines whether or not the related service was successfully provisioned (S928). If so, then the first service provider continues its processing at step S320 to determine whether or not access to the requested service should be granted. The process then concludes (steps S322 through S330) as described above.

When the related-service provisioning is unsuccessful, the first service provider may re-try to provision the related service (S930). Similar to the validation re-try described above, the provisioning authority, the first service provider or the third service provider may automatically attempt to provision the related service a predetermined number of times or upon certain conditions being satisfied. The user might instead be prompted to select whether or not related-service provisioning should be re-tried. If provisioning of the related service was unsuccessful and is not retried, the provisioning process continues at step S324 and an appropriate provisioning response is prepared and returned (S326) to the user.

When related-service provisioning is to be re-tried, the user may be prompted to enter some or all of the provisioning information, at step S932. For example, if the requested related service was denied because a preferred user name is already in use, then the user might be prompted for either a new user name or a different service provider prior to re-trying the related-service provisioning. In this example, if the unsuccessful related-service provisioning was executed for a third service provider, the first service provider may also indicate to the user whether or not the preferred user name is currently available on its system or check with one or more other service providers to determine if the user name is available on their respective systems and indicate which service providers may be able to provide the related service with the preferred user name. Similarly, alternate available user names on the third service provider system or a system of another service provider may be suggested to the user.

The user may then choose to re-try related-service provisioning with the same service provider or a different service provider. By selecting one of the suggested user names or service providers, the user increases the likelihood of successfully provisioning the related service.

Upon successful provisioning of the related service, the process proceeds with the service provisioning step S320 and S322 if appropriate. A provisioning response is then prepared (S324) and returned to the user (S326), device services are updated (S328) and the process ends at step S330. If the related service cannot be successfully provisioned and will not be retried, processing proceeds to step S324 and process concludes with steps S326 through S330.

Fig. 9c shows a similar process for an external service provider. The provisioning process for an external service provider is substantially the same as that for an "internal" service provider associated with the provisioning authority system and thus only the differences between these processes will be described in detail.

At step S934, the external service provider returns an indication that provisioning request processing will proceed, either when all required provisioning information is received or the external service provider determines that the provisioning request will be processed in the absence of any missing information. The provisioning process then continues at step S936 and proceeds to validate (steps S938 through S944) or provision (steps S956 through S962) the related service as described above. If the related service is validated (S946) or successfully provisioned (S964), then the process proceeds at step S340 to

determine if the user will be granted access to the requested service, the device is registered for service if appropriate (S342) and an indication of approval or denial of service is returned to the provisioning authority at step S344. The provisioning process then concludes at step S330, following preparation and transmission of a provisioning response (S324, S326) and updating of device services (S328).

The external provider process may also include related-service validation and provisioning re-try procedures, via steps S948 and S966, respectively. In the event of a related-service validation or provisioning failure, the validation or provisioning may be re-tried, with either the same information or new information requested from the user (S950, S954). When validation will not be re-tried, the user may also be given an option to attempt to provision a new related service, as described above. If related-service validation or provisioning has failed and will not be re-tried, or validation has failed and provisioning of a new related service will not be attempted, processing continues at step S344 to return an appropriate indication to the provisioning authority and the overall process concludes with steps S324 through S330.

It will be apparent to those skilled in the art that the above operations may be performed in a different order than described and shown in the Figs. 9a-9c. Also, some of the process steps and associated operations, such as the re-try procedures and the new related-service provisioning after a validation failure, are optional.

The illustrative embodiments of provisioning systems and processes in accordance with aspects of the invention have been described above primarily in the context of subscribing to or adding a new mobile device service. However, other provisioning requests, to delete or modify existing services for example, are also contemplated. The overall provisioning system and processes would be substantially as described above. A delete service or modify service provisioning request would preferably be submitted to a provisioning authority and processed by the provisioning authority and possibly a service provider. When the provisioning request has been processed, a provisioning response would preferably be returned to the user, via the device to which the service provisioning request relates or an alternate provisioning interface through which the provisioning request was submitted.

Fig. 10 shows a delete service operation which effectively removes a service for a particular device or user. It should be understood that a delete service provisioning request is prepared and submitted to the provisioning authority and initial provisioning request processing is substantially as described above. In particular, the process steps which precede steps S318 or S338, as well as the steps S344 (for an external service provider) and S324 through S330 as shown in Fig. 3 have not been shown in Fig. 10 in order to avoid congestion in the flow diagram.

A provisioning request is prepared using either the device or possibly an alternate provisioning interface and submitted to the provisioning authority, which extracts provisioning information and determines whether the service provider

which hosts the service to be deleted is associated with the provisioning authority system or an external service provider. The service provider or provisioning authority then determines if all required information has been received or if processing should continue in the absence of any missing information (S318/S338), as described above. The provisioning request preferably has a common format, including for example a request type field to indicate the type of provisioning request (add service, delete service, modify service) and information fields. Those skilled in the art will appreciate that different types of requests will include different information. For example, credit card and other billing information may be required in an add service provisioning request but not in a delete service request. Although the specific required information may be different for different types of requests, the checks in steps S318/S338 are preferably performed similarly regardless of the type of request.

When processing of a delete service provisioning request is to continue, the service to be deleted will preferably first be validated to verify that the service actually exists. The service information provided by the user is checked at step S1002, and at step S1004, it is determined whether or not the service could be validated. As described above, the validation may preferably be re-tried (S1006), possibly after new information is provided by the user (S1008) following a validation failure. If the service cannot be validated and validation will not be re-tried, then processing continues at step S324 or at step S344 for an external provider. An appropriate provisioning response is prepared and returned, records, menus or lists on the device may be updated to indicate a delete service

operation error or failure, and the delete service provisioning process ends. Deletion of a service, similar to add service provision as described above, may be conditional, for example where some further information may be required for completion of processing, the user has a billing amount outstanding, or perhaps some other service or account condition has not been satisfied.

If the service to be deleted is validated (S1004), the service provider or the provisioning authority may check to determine if the service to be deleted is related to any other device services, at step S1010. This step is preferred to avoid problems with any related services, but is not required. A check may instead be made at the device while a delete service provisioning request is being prepared, before the provisioning request is submitted to the provisioning authority, or after the service has been deleted. If the service is not related to any other device services, or if the related-service check is not performed, the service is deleted by the service provider (S1011) and the process continues as described above at step S324 or step S344. A delete service provisioning response confirms that the service has been deleted at the service provider and preferably initiates deletion of the service at the device, by updating device functions, service lists or menus, and possibly deleting applications related to the particular service. Deletion of a service preferably does not prevent the user from subscribing to the service at a later time through a further add service provisioning request.

Where a deleted service is related to another device service, such as in the above example of an email account and an email redirection service, the user

must reconfigure the other device service for an alternate related service. Since the provisioning authority preferably manages provisioning of all device services, the provisioning authority may perform the check at step S1010. This related-service check may instead be performed by a service provider, such as the service provider hosting the service to be deleted or the service provider hosting the related service.

If a related device service is found, then the delete service processing may be aborted, and the delete service provisioning response may indicate the reason for delete service failure. Alternatively, the provisioning authority or a service provider may, upon determination at step S1010 that a related service exists, send an alert to the user, at step S1012. When the alert is sent to the user, delete service processing preferably stops until a response is received from the user. The user further preferably has the option to specify in the response whether or not a new service with which the related service may be configured to operate should be provisioned before the delete service provisioning processing is complete, as shown at step S1014. If the user chooses to provision a new service to replace the service to be deleted, then the new service is provisioned (S1016), the old service is deleted (S1011), and the delete service processing continues at step S324 or S344 as described above. It will be apparent that the delete service process may first be concluded and an add service provisioning process may then be invoked to add a new service to replace the deleted service.

The user's response to the alert preferably also indicates whether or not the delete service process should continue. This would allow the user to choose to (i) provision a new replacement service and delete the old service only when the new service has been successfully added, (ii) not provision a new service but nonetheless delete the existing service, or (iii) not provision a new service and abort the delete service process. In the latter case, a new service could then be provisioned and configured to operate with the related service and the old service deleted if necessary at a later time. The delete service provisioning process may also be adapted to abort to step S324 or S344 as described above if so specified in the user's response to the alert or after a predetermined amount of time has elapsed without a response to the alert.

A modify service provisioning process is shown in Fig. 11. A user may wish to modify a service to subscribe to a different service plan for the same service, to add a device to or remove a device from an existing service account, to modify the device registered for a service when a new device is purchased, or to modify a billing address when a user relocates, for example. If the mobile device registered for a service incorporates a SIM card, a modify service provisioning request may also be prepared and submitted whenever the SIM card is to be used in a different device, when a new SIM card is to be used in the device, and other similar situations in which device or user information may change. When a service may be configured according to user-established preferences, the user may submit a modify service provisioning request to initially set preferences or modify existing settings.

A modify service provisioning request is preferably prepared and submitted to the provisioning authority and initial provisioning request processing is substantially as described above. As in Fig. 10, the process steps which precede steps S318 or S338, as well as the steps S344 (for an external service provider) and S324 through S330 as shown in Fig. 3 have not been shown in Fig. 11 but are common operations that may be executed during add service, delete service, modify service and possibly other provisioning processes.

The modify service provisioning request preferably conforms to a common request format as described above, and includes at least a modify service indicator, to specify that the provisioning request is a modify service request, and any required information. The specific information required for a modify service request may be different than for other types of requests, but will preferably include at least sufficient information to identify the particular service to which the request relates and authorization information to ensure that the entity submitting the request is authorized to effect changes in the service. The details on information required for a modify service request might also be sent to a device by the provisioning authority based on a service provider profile. At step S318/S338, the provisioning authority or service provider hosting the service to be modified determines whether or not all required information has been provided. As in the provisioning processes described above, further information may be requested if necessary.

When all information is received or processing of a modify service provisioning request is to continue without any missing information, the service

will preferably first be validated. The information provided by the user is checked at step S1102, and at step S1104, it is determined whether or not the service could be validated. The validation may preferably be re-tried (S1106), possibly after new information is provided by the user (S1108) following a validation failure. If the service cannot be validated and validation will not be re-tried, then processing continues at step S324, or at step S344 for an external provider. A provisioning response is prepared and returned, records, menus or lists on the device may then be updated to indicate that a modify service error or failure has occurred, and the provisioning process ends. Any changes to a service may be conditional, for example where any further information may be required for completion of processing, the user's service account is not in good standing and the like.

Upon validation of the service (S1104), the service provider or the provisioning authority may check to determine if any of the requested changes to the service will affect any other device services, at step S1110. This step is optional, but preferred in order to avoid problems with such related services. A similar check may instead be made at the device, as described above for a delete service provisioning request, while a modify service provisioning request is being prepared, before the modify service provisioning request is submitted to the provisioning authority, or after the service has been modified. If the service is not related to any other device services, or if the related-service check is not performed, the service is then modified by the service provider (S1111) and the process continues at step S324 or step S344. A provisioning response to a

modify service provisioning request confirms that the service has been modified at the service provider and preferably initiates any required changes to the service or service-related applications at the device. If necessary, further changes to the same service may also be made at a later time through a further modify service provisioning request.

Where the service is related to another device service, such as in the above example of an email account and an email redirection service, the user may be required to reconfigure the other device service to reflect any service changes. Since the provisioning authority preferably manages provisioning of all device services, the provisioning authority may perform the check at step S1110. This related-service check may instead be performed by a service provider, such as the service provider hosting the service to be changed or the service provider hosting the related service.

If a related device service is found and will be affected by any change requested in the provisioning request, then the modify service processing may be aborted as shown at the right-hand side of block S1110, and the modify service provisioning response may indicate the reason for the modify service process failure. Alternatively, the provisioning authority or a service provider may, upon an affirmative determination at step S1110, send an alert to the user, at step S1112. When the alert is sent to the user, processing preferably stops until a response is received from the user. The user further preferably has the option to specify in the response whether or not he or she wishes to redefine the requested changes, including but in no way limited to specifying new changes or

effectively cancelling certain requested changes, and whether or not the modify service processing should proceed. If the user chooses to redefine the requested changes, by specifying new changes or cancelling some of the requested changes for example, then the new changes are specified (S1116), the new changes are made at the service provider (S1111), and the modify service processing continues at step S324 or S344 as described above.

The user's response to the alert may instead indicate that the requested changes will not be redefined and that the modify process should either proceed or be aborted (S1118). If the user chooses to proceed with the requested changes, then the changes are made at step S1111 and the process continues at step S324 or S344. If the user chooses to abort the modify process, no changes to the service are made and the process continues at step S324 or S344. The modify service provisioning process may also be adapted to abort to step S324 or S344 as described above after a predetermined amount of time has elapsed without a response to the alert.

Add service provisioning, delete service provisioning and modify service provisioning have been described above and shown in the drawings as separate processes. However, the provisioning application at the device 14 and associated provisioning arrangements at the provisioning authority and service provider systems may be configured to determine a type of any received provisioning request, such that the provisioning process includes common provisioning request preparation, submission, and information extraction and distribution operations, as well as common provisioning response preparation

and transmission operations, with different but possibly inter-related processing operations for the particular types of provisioning requests. Incorporation of the add, delete and modify service flow diagrams shown in the drawings into a single overall flow diagram for such a combined provisioning process adapted for multiple provisioning request types will be apparent to those skilled in the art.

Thus, a provisioning system and method in accordance with various aspects of the invention may manage multiple provisioning functions for a plurality of internal and external service providers.

Having described provisioning systems and methods, a mobile communication device in which the provisioning application may be installed will now be described. Fig. 12 is a block diagram of such a mobile communication device 1210. The mobile communication device 1210 is preferably a two-way communication device having at least voice or data communication capabilities. The device preferably has the capability to communicate with other computer systems on the Internet. Depending on the functionality provided by the device, the device may be referred to as a data messaging device, a two-way pager, a cellular telephone with data messaging capabilities, a wireless Internet appliance or a data communication device (with or without telephony capabilities).

Where the device 1210 is enabled for two-way communications, the device will incorporate a communication subsystem 1211, including a receiver 1212, a transmitter 1214, and associated components such as one or more, preferably embedded or internal, antenna elements 1216 and 1218, local oscillators (LOs) 1213, and a processing module such as a digital signal

processor (DSP) 1220. As will be apparent to those skilled in the field of communications, the particular design of the communication subsystem 1211 will be dependent upon the communication network in which the device is intended to operate. For example, a device 1210 destined for a North American market may include a communication subsystem 1211 designed to operate within the Mobitex™ mobile communication system or DataTAC™ mobile communication system, whereas a device 1210 intended for use in Europe may incorporate a GPRS communication subsystem 1211.

Network access requirements will also vary depending upon the type of network 1219. For example, in the Mobitex and DataTAC networks, mobile devices such as 1210 are activated on the network using a unique identification number associated with each device. In GPRS networks however, network access is associated with a subscriber or user of a device 1210. A GPRS device therefore requires a SIM card, as described above, in order to operate on a GPRS network. Without a SIM card, a GPRS device will not be fully functional. Local or non-network communication functions may be operable, but the device 1210 will be unable to carry out any functions involving communications over network 1219, except perhaps for legally required communication functions. When required network activation procedures have been completed, a device 1210 may send and receive communication signals over the network 1219. Signals received by the antenna 1216 through a communication network 1219 are input to the receiver 1212, which may perform such common receiver functions as signal amplification, frequency down conversion, filtering, channel

selection and the like, and in the example system shown in Fig. 12, analog to digital conversion. Analog to digital conversion of a received signal allows more complex communication functions such as demodulation and decoding to be performed in the DSP 1220. In a similar manner, signals to be transmitted are processed, including modulation and encoding for example, by the DSP 1220 and input to the transmitter 1214 for digital to analog conversion, frequency up conversion, filtering, amplification and transmission over the communication network 1219 via the antenna 1218.

The DSP 1220 not only processes communication signals, but also provides for receiver and transmitter control. For example, the gains applied to communication signals in the receiver 1212 and transmitter 1214 may be adaptively controlled through automatic gain control algorithms implemented in the DSP 1220.

The device 1210 preferably includes a microprocessor 1238 which controls the overall operation of the device. Communication functions, including at least data and voice communications, are performed through the communication subsystem 1211. The microprocessor 1238 also interacts with further device subsystems such as the display 1222, flash memory 1224, random access memory (RAM) 1226, auxiliary input/output (I/O) subsystems 1228, serial port 1230, keyboard 1232, speaker 1234, microphone 1236, a short-range communications subsystem 1240 and any other device subsystems generally designated as 1242.

Some of the subsystems shown in Fig. 12 perform communication-related functions, whereas other subsystems may provide "resident" or on-device functions. Notably, some subsystems, such as keyboard 1232 and display 1222 for example, may be used for both communication-related functions, such as entering a text message for transmission over a communication network, and device-resident functions such as a calculator or task list.

Software such as an operating system and the provisioning application described above is preferably stored in a persistent store such as flash memory 1224, which may instead be a read only memory (ROM) or similar storage element (not shown). Those skilled in the art will appreciate that the operating system, specific device applications including a provisioning application, or parts thereof, may be temporarily loaded into a volatile store such as RAM 1226. It is contemplated that received communication signals may also be stored to RAM 1226.

The microprocessor 1238, in addition to its operating system functions, preferably enables execution of software applications on the device. A predetermined set of applications which control basic device operations, including at least data and voice communication applications for example, will normally be installed on the device 1210 during manufacture. A preferred application that may be loaded onto the device may be a personal information manager (PIM) application having the ability to organize and manage data items relating to the device user such as, but not limited to e-mail, calendar events, voice mails, appointments, and task items. Naturally, one or more memory stores

would be available on the device to facilitate storage of PIM data items on the device. Such PIM application would preferably have the ability to send and receive data items, via the wireless network. In a preferred embodiment, the PIM data items are seamlessly integrated, synchronized and updated, via the wireless network, with the device user's corresponding data items stored or associated with a host computer system thereby creating a mirrored host computer on the mobile device with respect to the data items at least. This would be especially advantageous in the case where the host computer system is the mobile device user's office computer system. Further applications may also be loaded onto the device 1210 through the network 1219, an auxiliary I/O subsystem 1228, serial port 1230, short-range communications subsystem 1240 or any other suitable subsystem 1242, and installed by a user in the RAM 1226 or preferably a non-volatile store (not shown) for execution by the microprocessor 1238. Such flexibility in application installation increases the functionality of the device and may provide enhanced on-device functions, communication-related functions, or both. For example, secure communication applications may enable electronic commerce functions and other such financial transactions to be performed using the device 1210.

In a data communication mode, a received signal such as a text message or web page download will be processed by the communication subsystem 1211 and input to the microprocessor 1238, which will preferably further process the received signal for output to the display 1222, or alternatively to an auxiliary I/O device 1228. A user of device 1210 may also compose data items such as email

messages for example, using the keyboard 1232, which is preferably a complete alphanumeric keyboard or telephone-type keypad, in conjunction with the display 1222 and possibly an auxiliary I/O device 1228. Such composed items may then be transmitted over a communication network through the communication subsystem 1211.

For voice communications, overall operation of the device 1210 is substantially similar, except that received signals would preferably be output to a speaker 1234 and signals for transmission would be generated by a microphone 1236. Alternative voice or audio I/O subsystems such as a voice message recording subsystem may also be implemented on the device 1210. Although voice or audio signal output is preferably accomplished primarily through the speaker 1234, the display 1222 may also be used to provide an indication of the identity of a calling party, the duration of a voice call, or other voice call related information for example.

The serial port 1230 in Fig. 12 would normally be implemented in a personal digital assistant (PDA)-type communication device for which synchronization with a user's desktop computer (not shown) may be desirable, but is an optional device component. Such a port 1230 would enable a user to set preferences through an external device or software application and would extend the capabilities of the device by providing for information or software downloads to the device 1210 other than through a wireless communication network. The alternate download path may for example be used to load an

encryption key onto the device through a direct and thus reliable and trusted connection to thereby enable secure device communication.

A short-range communications subsystem 1240 is a further optional component which may provide for communication between the device 1224 and different systems or devices, which need not necessarily be similar devices. For example, the subsystem 1240 may include an infrared device and associated circuits and components or a Bluetooth™ communication module to provide for communication with similarly-enabled systems and devices.

It will be appreciated that the above description relates to the preferred embodiment by way of example only. Many variations on the invention will be obvious to those knowledgeable in the field, and such obvious variations are within the scope of the invention as described and claimed, whether or not expressly described.

For example, although a single provisioning authority preferably provides a provisioning interface between multiple service providers and devices which may use services hosted by such service providers, it will be apparent that more than one such provisioning authority, each serving one or more service providers, may be implemented in a system.

In multiple provisioning authority systems, each authority is preferably adapted to operate with a common provisioning application. However, it is also contemplated that different provisioning authorities may use different provisioning applications. Intermediate interface or translation systems may provide for communication between a device provisioning application and a provisioning

authority adapted for a different provisioning application. Alternatively, a device may download a corresponding different provisioning application from a particular provisioning authority, a service provider that uses the particular provisioning authority, or possibly from another provisioning application source such as a central repository of provisioning applications. Depending upon the service to be provisioned, the service provider hosting the service and its associated provisioning authority, a particular corresponding one of a plurality of stored provisioning applications may be invoked on a device.

Further contemplated aspects of the invention relate to service query and notify functions. In accordance with these aspects of the invention, a device may query a provisioning authority to determine which services may be provisioned via the provisioning authority, and possibly which service providers host such services. If necessary, a user may then download a corresponding provisioning application and provision any desired services using the provisioning application and provisioning authority. A service notify feature may be implemented by a service provider or a provisioning authority as an advertizing mechanism, whereby the service provider or provisioning authority notifies mobile devices of available services. A service notify message may be sent to a device upon conclusion of a first provisioning operation for the device, as an attachment to or following a transmission of a provisioning response for example. Such a message might also be sent to all devices that have previously used a particular provisioning authority or service provider, when a new service or service provider becomes available.

Those skilled in the art will also appreciate that other alternate provisioning interfaces in addition to those shown in the drawings may be provided. One such alternate interface that may not be immediately apparent is another mobile communication device. For example, a user may wish to provision device services using a device on which a provisioning application has not been installed, or perhaps when the device is out of mobile communication network coverage or would incur roaming charges for any network communications. If the device and a second available device are enabled for short-range communications as described above, then "proxy" type provisioning may be possible. The second device may download, if necessary, the appropriate provisioning application. Any information required for the intended provisioning operation is transferred from the first device to the second device via the short-range link, and the provisioning application on the second device prepares and submits the provisioning request and receives the provisioning response on behalf of the user of the first device. If the provisioning application is resident on the first device, then the provisioning application may be transferred to the second device from the first device via the short-range communications link if necessary, or the provisioning request could be prepared on the first device and submitted to the provisioning authority via the second device. The provisioning response may then be received by the second device and similarly transferred to the first device via the short-range link.

WHAT IS CLAIMED AS THE INVENTION IS:

1. A method of provisioning services comprising a first communication service of a first service provider of a first communication system and a second communication service of a second service provider of a second communication system for a mobile communication device, the method comprising the steps of:

receiving at a provisioning authority a service activation request, for the first communication service;

determining whether the second communication service has been activated for the mobile communication device by validating the mobile communication device with the second service provider; and

where the second communication service has been activated for the mobile communication device, then:

processing the activation information to determine with the first service provider whether the activation operation may be performed;

performing the activation operation for the first communication service where the activation operation may be performed;

preparing an activation response indicating the result of the activation; and

sending the activation response to the mobile communication device; and

where the second communication service has not been activated for the mobile communication device, then:

aborting the activation operation;

preparing an activation response indicating that the activation operation was unsuccessful; and

sending the activation response to the mobile communication device.

2. The method of claim 1, wherein the second communication service is an electronic messaging service.

3. The method of claim 2, wherein the first communication service is an electronic message redirection service which redirects electronic messages received at an electronic messaging service system to the mobile communication device.

4. The method of claim 1, wherein the method steps are performed at the provisioning authority system.

5. The method of claim 1, wherein the steps of receiving, preparing and sending are performed at the provisioning authority system.

6. The method of claim 5, wherein the step of determining is performed at the provisioning authority system.

7. The method of claim 5, wherein the steps of processing and performing are executed by the provisioning authority system.

8. The method of claim 5, wherein the steps of processing and performing are executed by the first service provider of the first communication service.

9. The method of claim 5, wherein the step of determining is performed by the first service provider of the first communication service.

10. The method of claim 8, wherein the step of determining is performed by the second service provider of the second communication service.

11. The method of claim 1, wherein the step of processing comprises the steps of:

determining whether additional activation information is required for the activation operation; and

requesting the additional activation information from the mobile communication device where additional activation information is required for the activation operation.

12. The method of claim 1, wherein the activation information includes mobile communication device information and user information.

13. The method of claim 12, wherein the mobile communication device information is retrieved from a memory in the mobile communication device.

14. The method of claim 1, wherein the step of receiving an activation request comprises the step of receiving the activation request from the mobile communication device.

15. The method of claim 1, wherein the step of receiving an activation request comprises the step of receiving the activation request from a computer system interface.

16. A provisioning authority system for managing service activation for mobile communication devices in a wireless communication system, comprising:

at least one provisioning interface;

means for receiving an activation request, operatively associated with each of the at least one interface systems, wherein the activation request is associated with a first communication service of a first service provider;

means for extracting activation information from the activation request;

means for distributing the activation information, wherein the means for distributing distributes the activation information to one of a plurality of means for processing activation information;

means for determining whether granting the activation request affects a second communication service of a second service provider of the mobile communication device, wherein

if the second communication service has been activated for the mobile communication device, then the means are configured to:

process the activation information to determine with the first service provider whether the activation operation may be performed;

perform the activation operation for the first communication service where the activation operation may be performed;

and wherein

if the second communication service has not been activated for the mobile communication device, then the means are configured to:

abort the activation operation;

means for preparing an activation response indicating the result of the activation request; and

means for sending the activation response to the provisioning interface from which the request was received.

17. The system of claim 16, wherein the plurality of means for processing activation information comprises means for processing associated with services provided by the provisioning authority system.

18. The system of claim 16, wherein the one of the plurality means for processing activation information processes the activation information to determine whether the activation request should be granted.

19. The system of claim 16, wherein the means for distributing further distributes the activation information to a billing system.

20. The system of claim 16, wherein the means for distributing further distributes the activation information to a mobile communication device warranty tracking system.

21. The system of claim 16, further comprising:

means for storing profile information for each of the plurality of means for

processing activation information;

means for determining whether additional activation information is required to grant the activation request, based on the profile information; and

means for requesting any required additional activation information from the interface system from which the activation request was received, where additional activation information is required to grant the activation request.

22. The system of claim 16, further comprising:

means for sending an alert to the provisioning interface from which the activation request was received, where granting the activation request affects the second communication service; and

means for receiving a response to the alert from the mobile communication

device, the response specifying that the processing of the activation information should either be aborted or proceed.

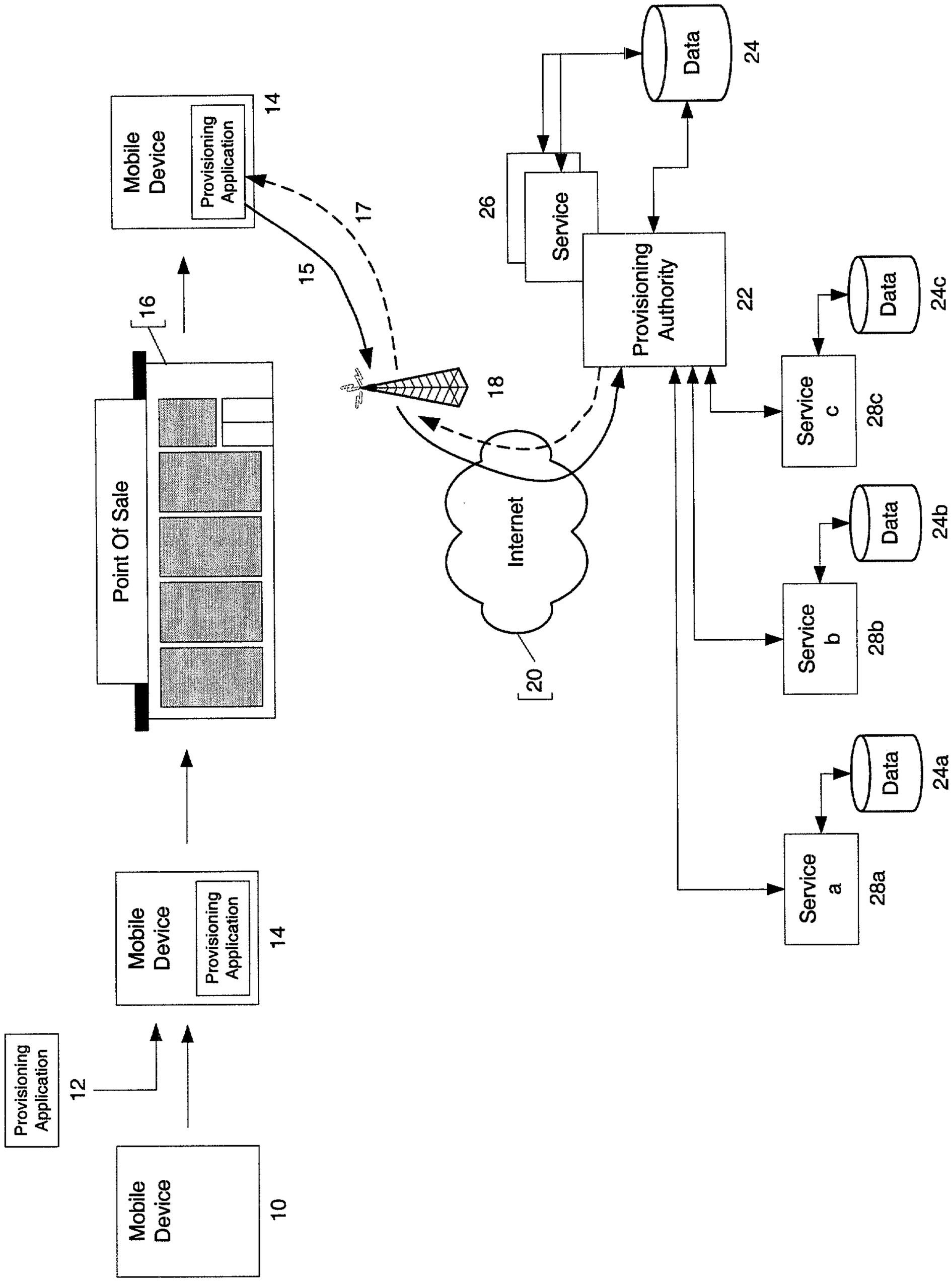

Mobile Device
Provisioning Application
14
17
15
16
Point Of Sale
18
Internet
20
Data
24
26
Service
Provisioning Authority
22
Data
24c
Service c
28c
Data
24b
Service b
28b
Data
24a
Service a
28a
Provisioning Application
12
Mobile Device
Provisioning Application
14
Mobile Device
10

FIG. 1

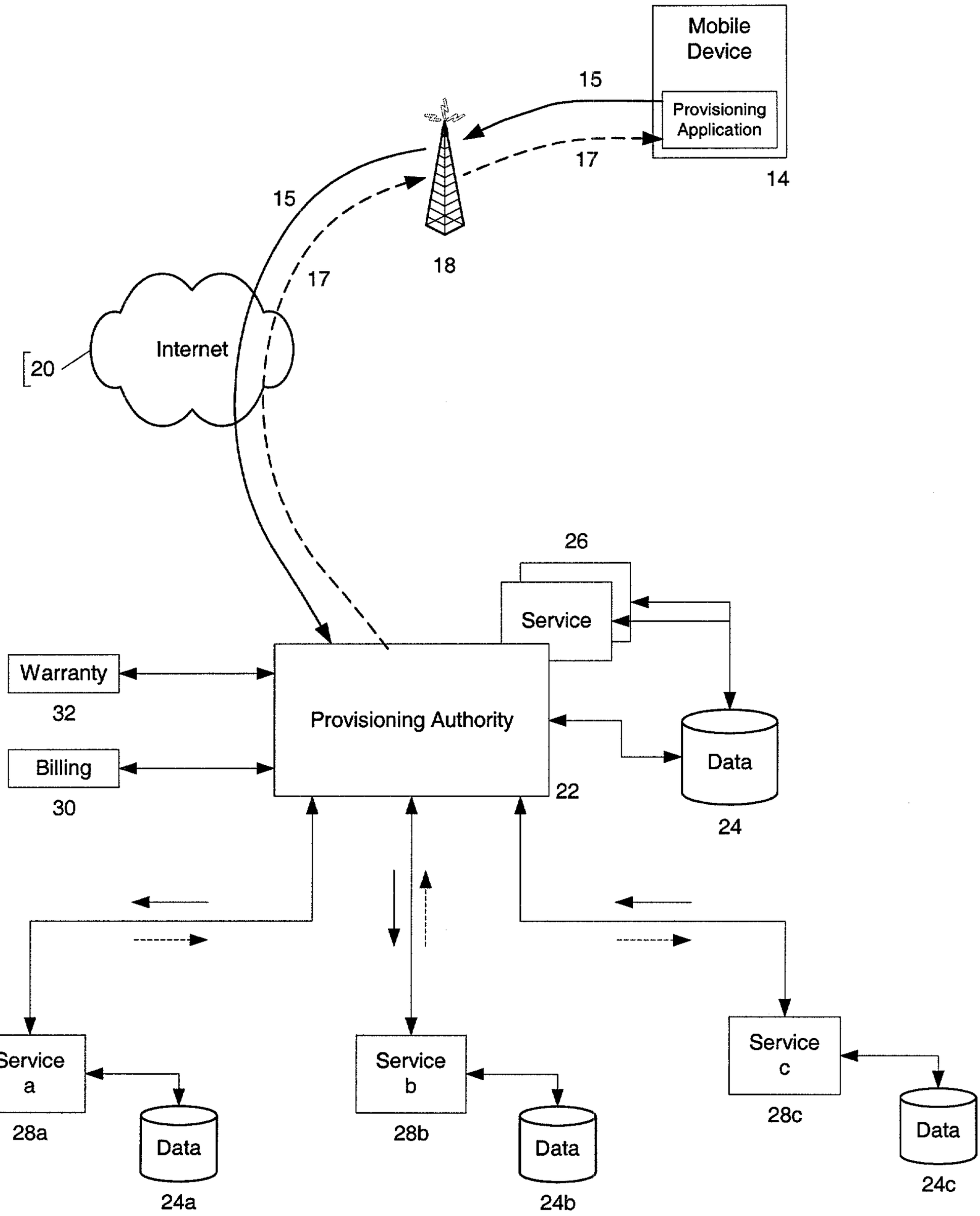

Mobile Device
15
Provisioning Application
17
14
15
18
17
Internet
20
26
Service
Warranty
32
Provisioning Authority
Data
Billing
30
22
24
Service a
Service b
Service c
28a
28b
28c
Data
Data
Data
24a
24b
24c

FIG. 2

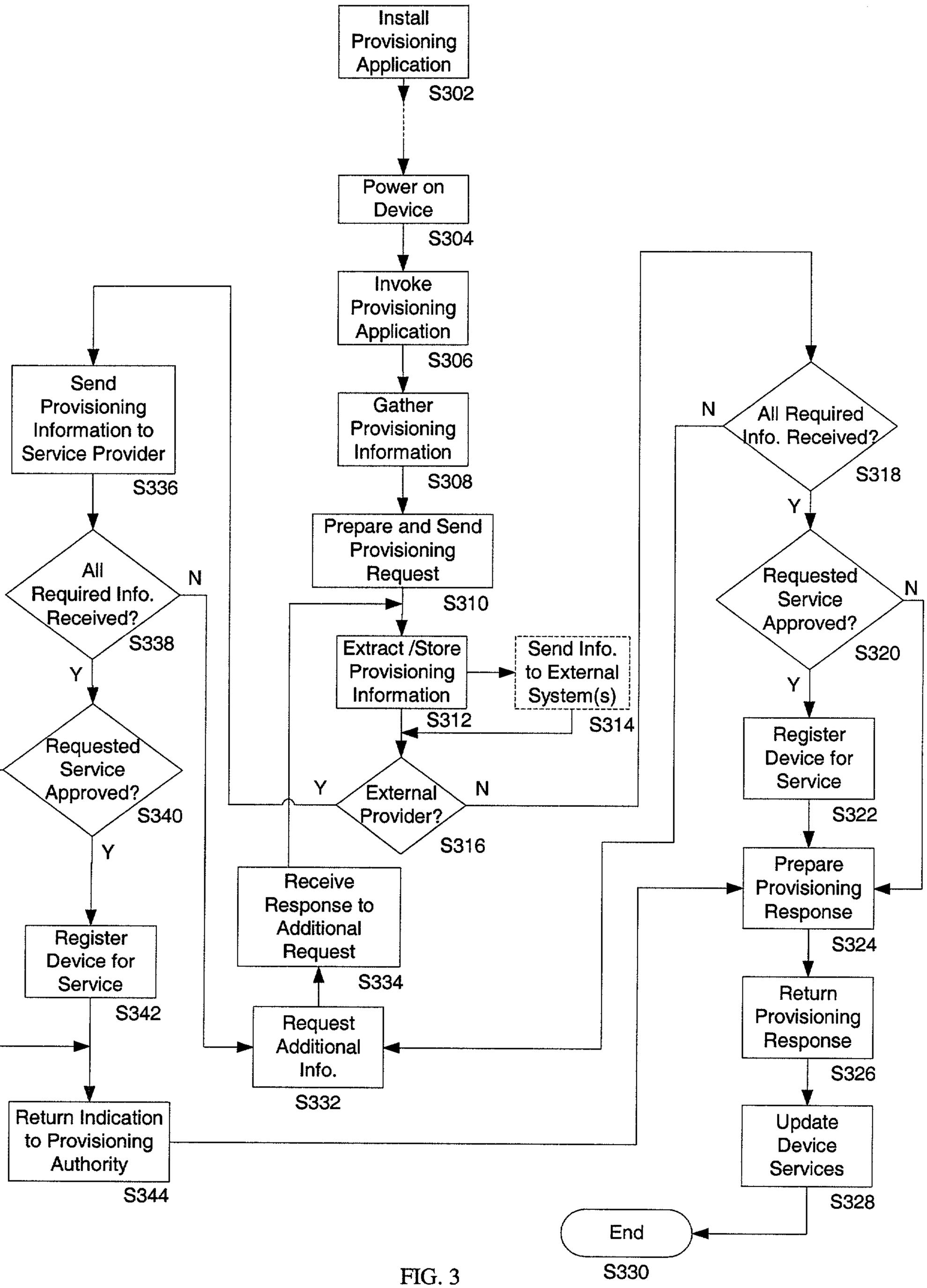

Install Provisioning Application
S302
Power on Device
S304
Invoke Provisioning Application
S306
Gather Provisioning Information
S308
Prepare and Send Provisioning Request
S310
Extract /Store Provisioning Information
S312
Send Info. to External System(s)
S314
External Provider?
S316
Y
N
Receive Response to Additional Request
S334
Request Additional Info.
S332
All Required Info. Received?
S318
N
Y
Requested Service Approved?
S320
N
Y
Register Device for Service
S322
Prepare Provisioning Response
S324
Return Provisioning Response
S326
Update Device Services
S328
End
S330
Send Provisioning Information to Service Provider
S336
All Required Info. Received?
S338
N
Y
Requested Service Approved?
S340
N
Y
Register Device for Service
S342
Return Indication to Provisioning Authority
S344

FIG. 3

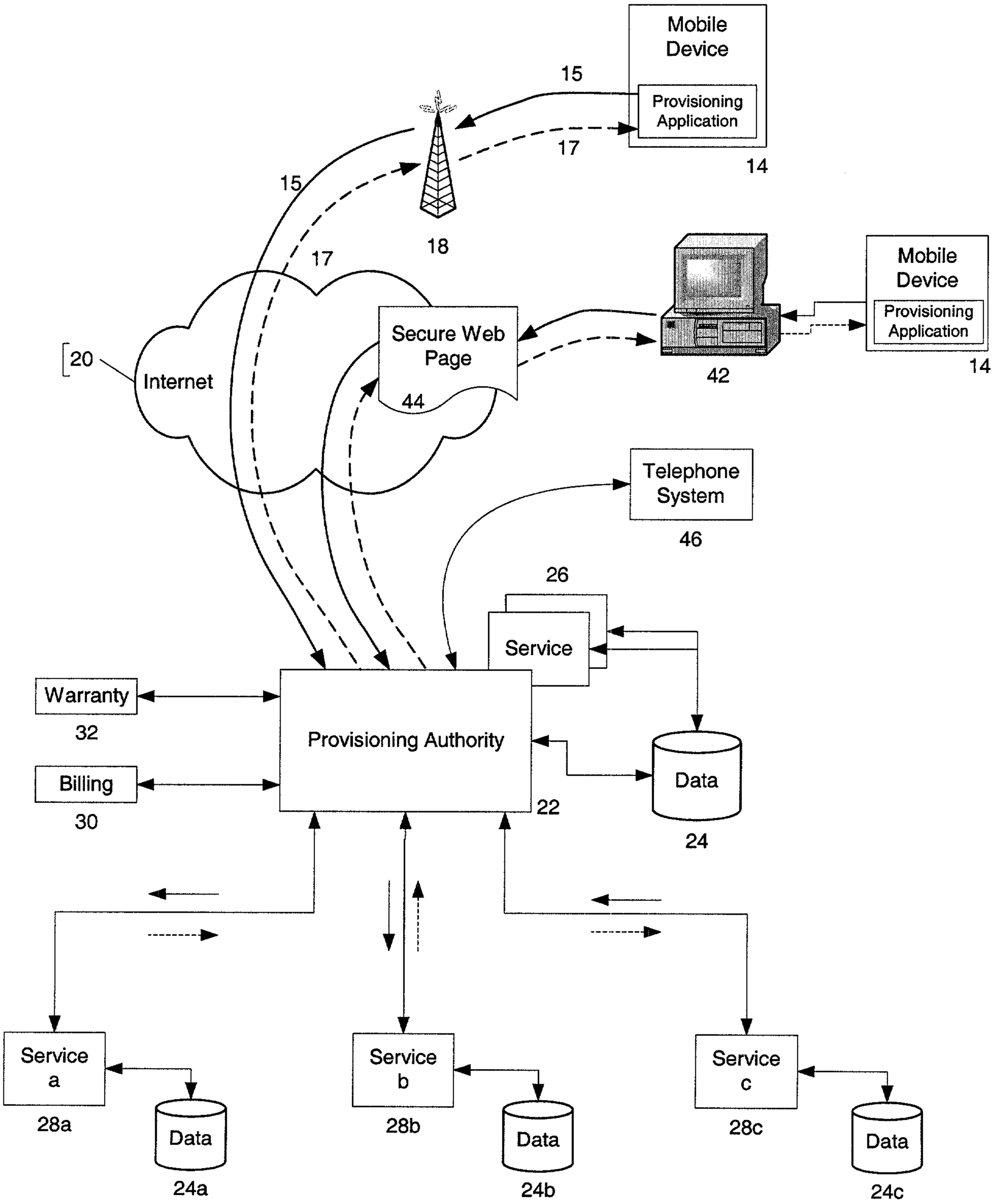

Mobile Device
Provisioning Application
14
15
17
15
18
17
20
Internet
Secure Web Page
44
42
Mobile Device
Provisioning Application
14
Telephone System
46
26
Service
Warranty
32
Billing
30
Provisioning Authority
22
Data
24
Service a
28a
Data
Service b
28b
Data
Service c
28c
Data
24a
24b
24c

FIG. 4

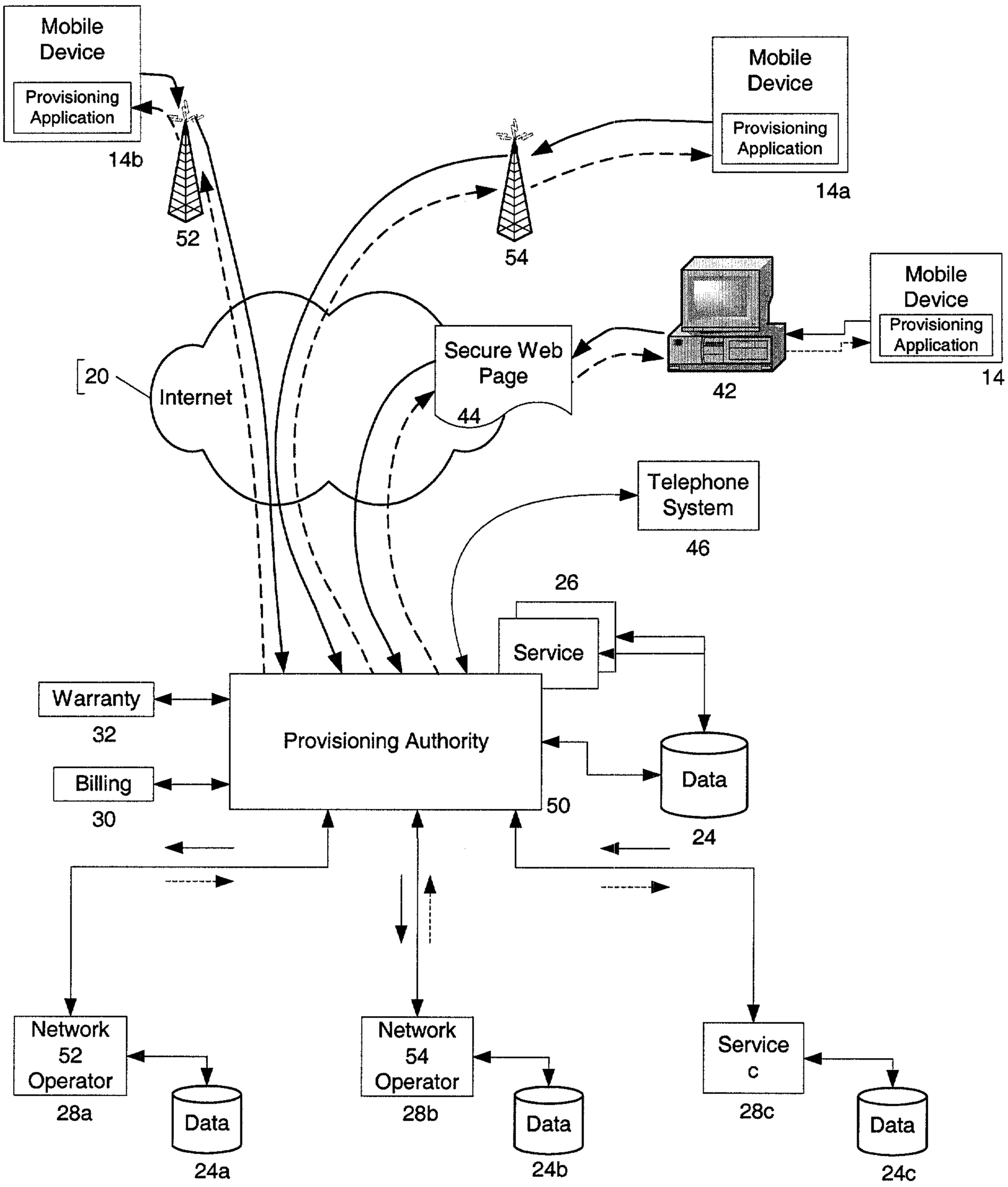

Mobile Device
Provisioning Application
14b
52
54
Mobile Device
Provisioning Application
14a
Mobile Device
Provisioning Application
14
42
Secure Web Page
44
20
Internet
Telephone System
46
26
Service
Warranty
32
Billing
30
Provisioning Authority
50
Data
24
Network 52 Operator
28a
Data
24a
Network 54 Operator
28b
Data
24b
Service c
28c
Data
24c

FIG. 5

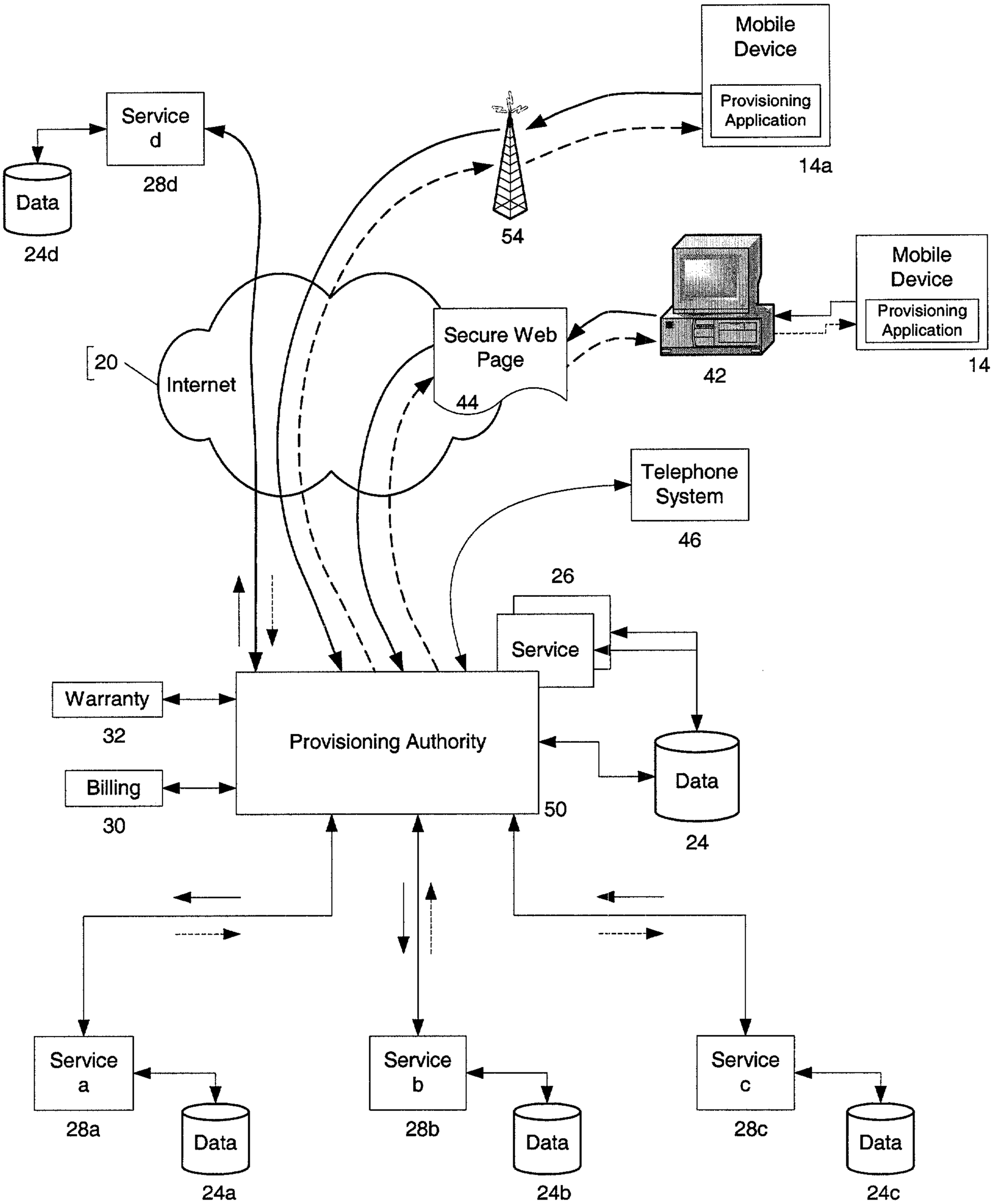

Service d
28d
Data
24d
Mobile Device
Provisioning Application
14a
54
Secure Web Page
44
20
Internet
42
Mobile Device
Provisioning Application
14
Telephone System
46
26
Service
Warranty
32
Billing
30
Provisioning Authority
50
Data
24
Service a
28a
Data
24a
Service b
28b
Data
24b
Service c
28c
Data
24c

FIG. 6

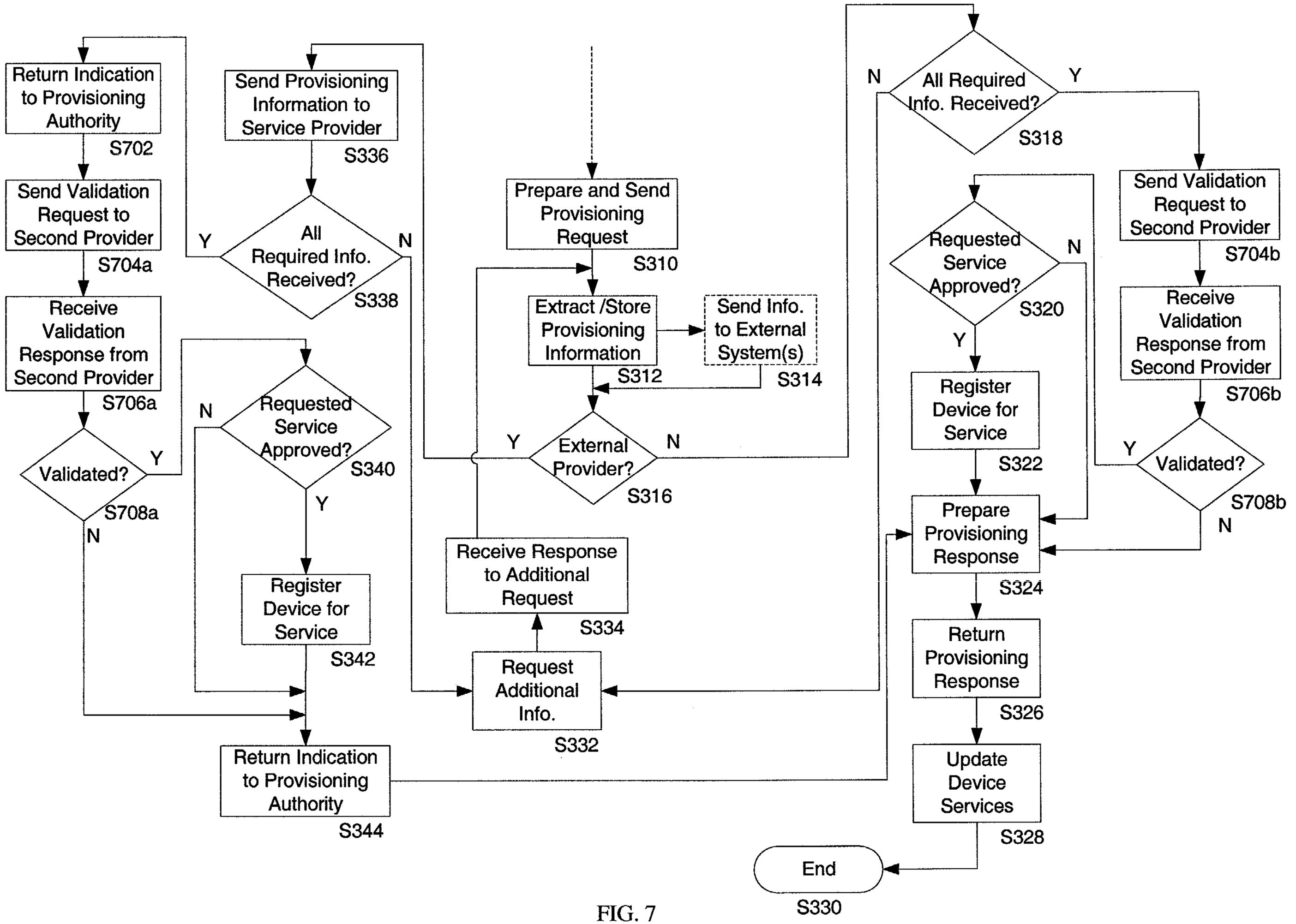


FIG. 7

CA 02356823 2001-09-10

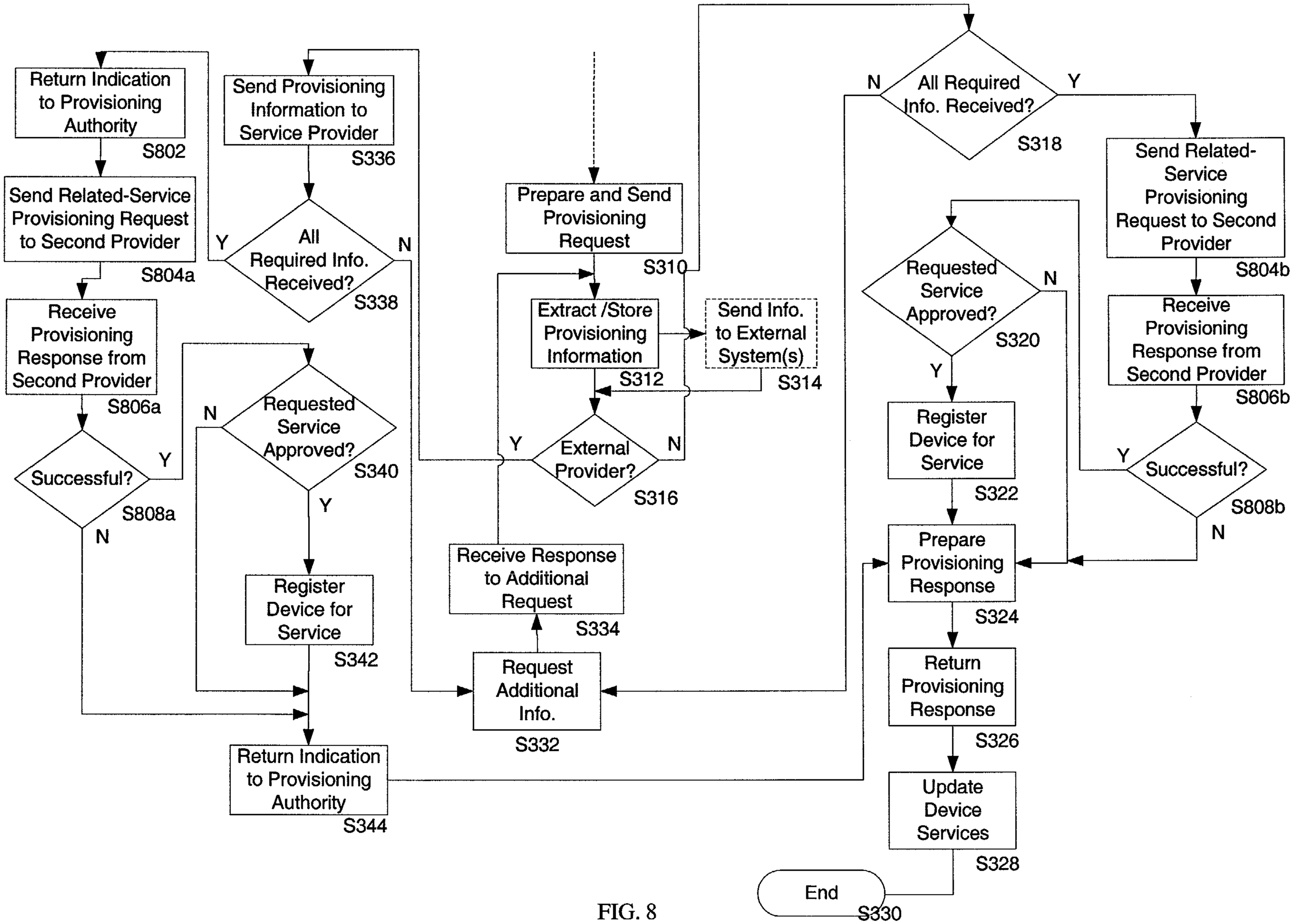


FIG. 8

CA 02356823 2001-09-10

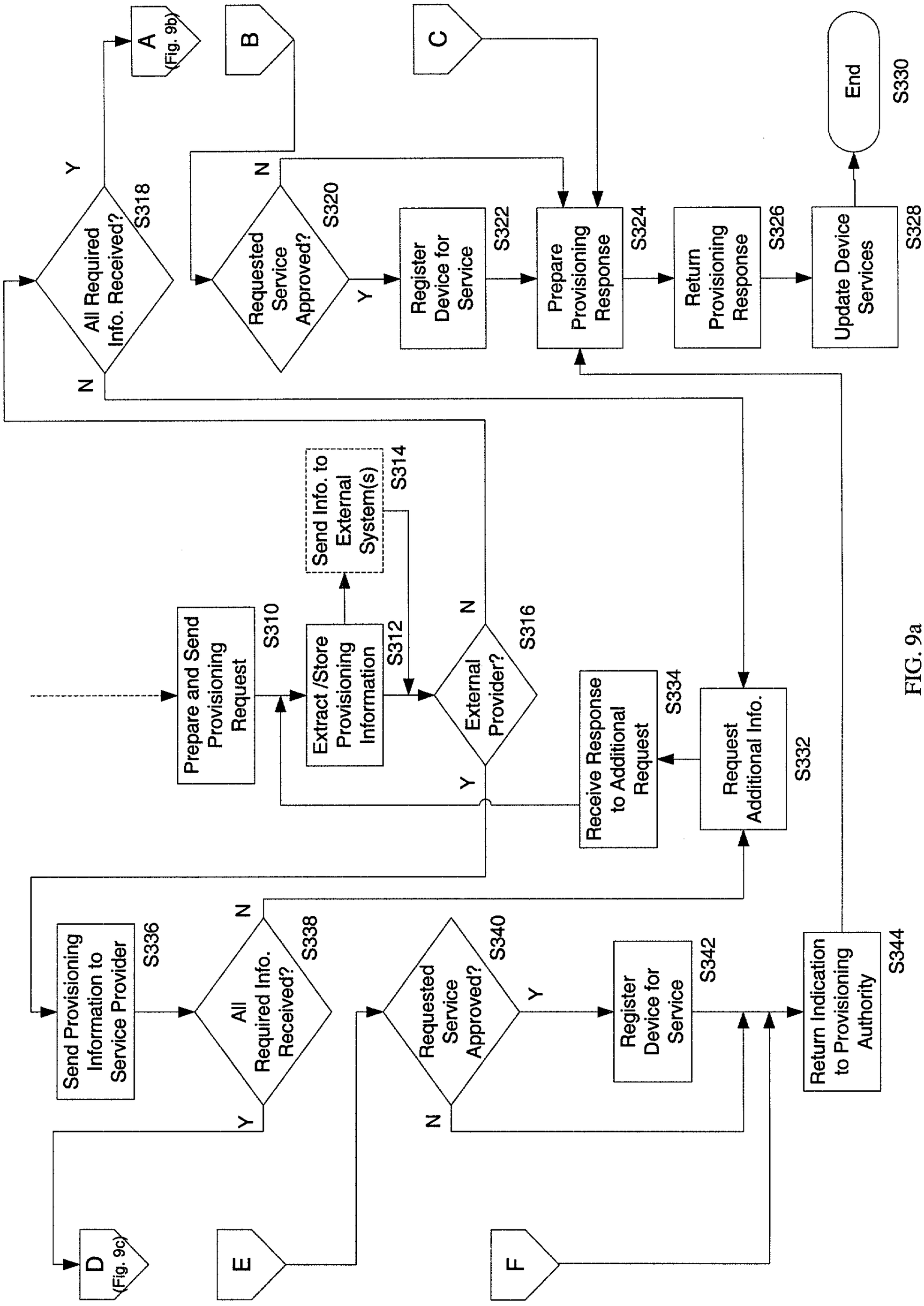

A
(Fig. 9b)
B
C
Y
All Required Info. Received?
S318
N
N
Requested Service Approved?
S320
Y
Register Device for Service
S322
Prepare Provisioning Response
S324
Return Provisioning Response
S326
Update Device Services
S328
End
S330
Send Info. to External System(s)
S314
Prepare and Send Provisioning Request
S310
Extract /Store Provisioning Information
S312
N
External Provider?
S316
Y
Receive Response to Additional Request
S334
Request Additional Info.
S332
Send Provisioning Information to Service Provider
S336
N
All Required Info. Received?
S338
Y
Requested Service Approved?
S340
N
Y
Register Device for Service
S342
Return Indication to Provisioning Authority
S344
D
(Fig. 9c)
E
F

FIG. 9a

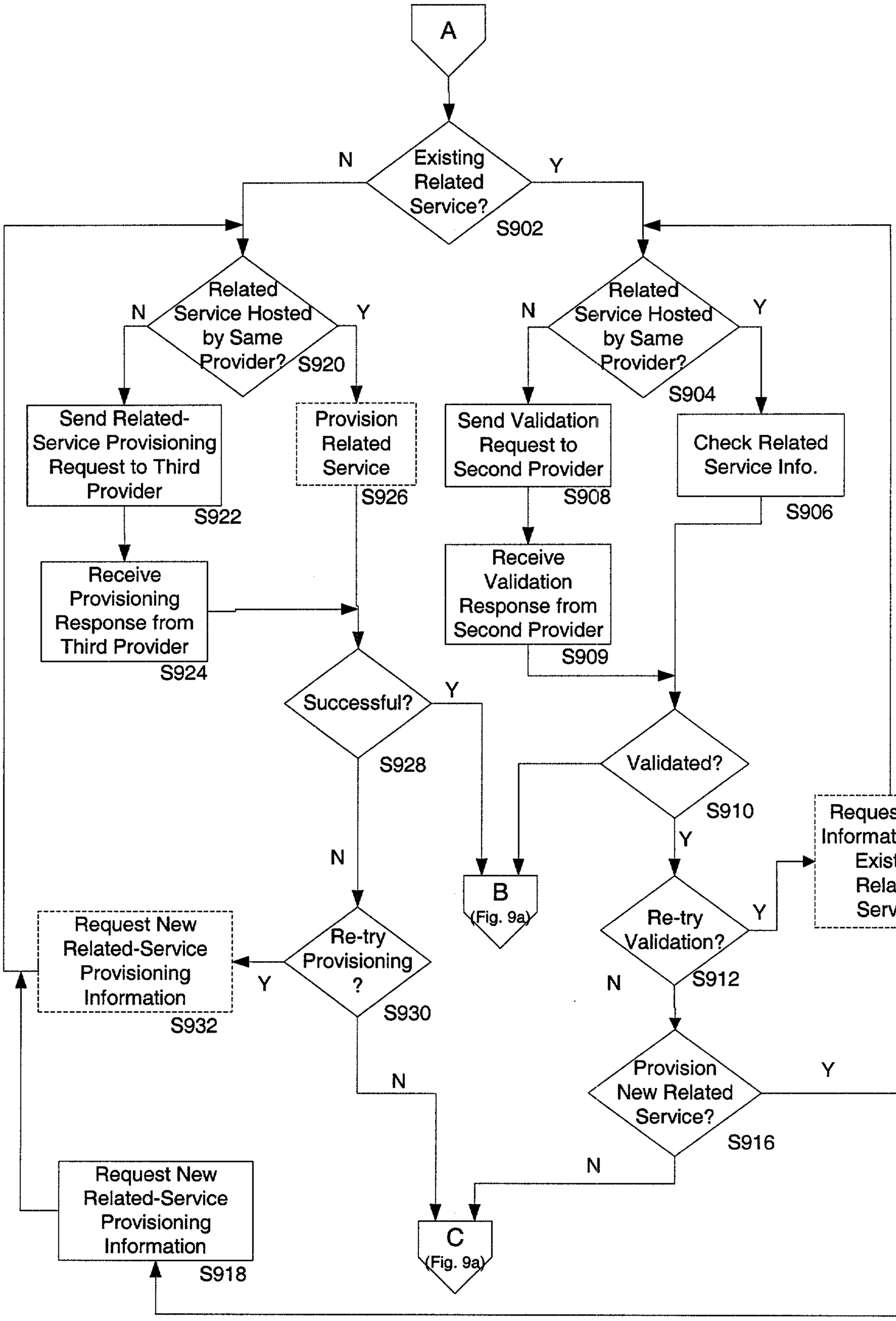

A
Existing Related Service?
S902
N
Y
Related Service Hosted by Same Provider?
S920
Related Service Hosted by Same Provider?
S904
Send Related-Service Provisioning Request to Third Provider
S922
Provision Related Service
S926
Send Validation Request to Second Provider
S908
Check Related Service Info.
S906
Receive Provisioning Response from Third Provider
S924
Receive Validation Response from Second Provider
S909
Successful?
S928
Validated?
S910
Request New Information For Existing Related Service
S914
B
(Fig. 9a)
Re-try Validation?
S912
Request New Related-Service Provisioning Information
S932
Re-try Provisioning ?
S930
Provision New Related Service?
S916
Request New Related-Service Provisioning Information
S918
C
(Fig. 9a)

FIG. 9b

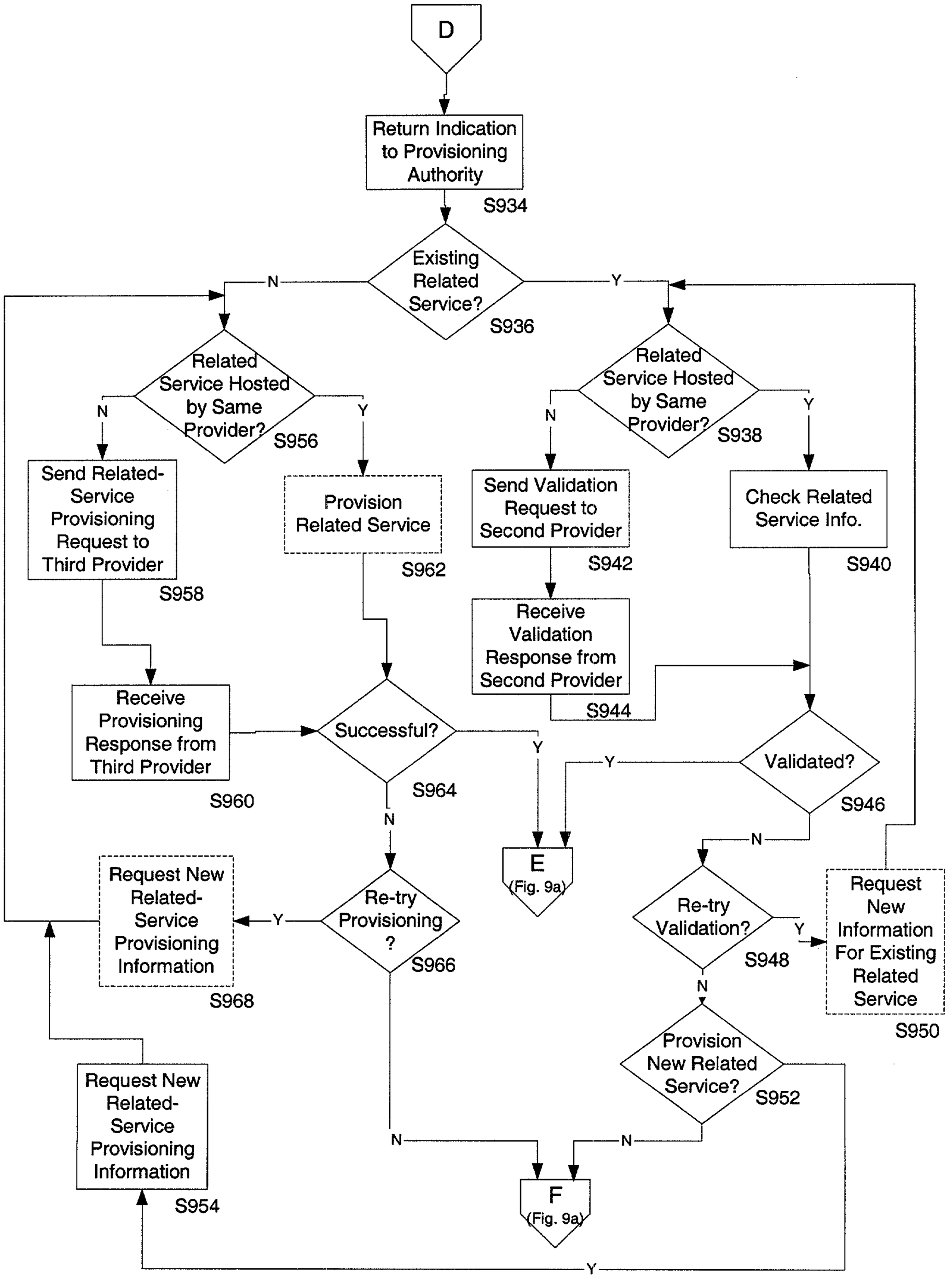

D
Return Indication to Provisioning Authority
S934
Existing Related Service?
S936
N
Y
Related Service Hosted by Same Provider?
S956
N
Y
Send Related-Service Provisioning Request to Third Provider
S958
Provision Related Service
S962
Receive Provisioning Response from Third Provider
S960
Successful?
S964
N
Y
Request New Related-Service Provisioning Information
S968
Re-try Provisioning ?
S966
Y
N
Request New Related-Service Provisioning Information
S954
E
(Fig. 9a)
Related Service Hosted by Same Provider?
S938
N
Y
Send Validation Request to Second Provider
S942
Receive Validation Response from Second Provider
S944
Check Related Service Info.
S940
Validated?
S946
Y
N
Re-try Validation?
S948
Y
N
Request New Information For Existing Related Service
S950
Provision New Related Service?
S952
N
N
F
(Fig. 9a)
Y

FIG. 9c

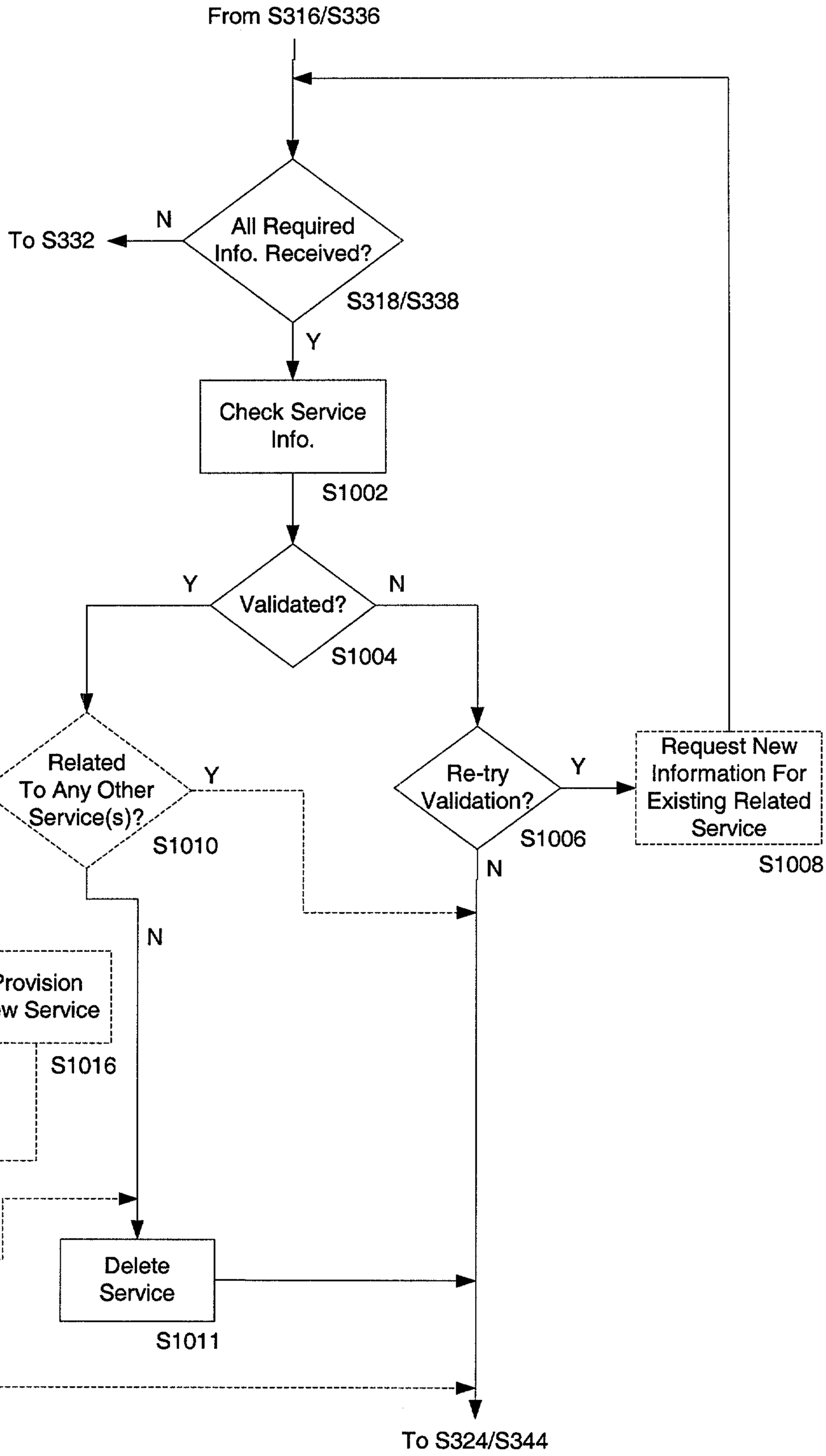

From S316/S336
All Required Info. Received?
N
To S332
S318/S338
Y
Check Service Info.
S1002
Validated?
Y
N
S1004
Related To Any Other Service(s)?
(Y)
Y
N
S1010
Send Alert to User
S1012
Re-try Validation?
Y
N
S1006
Request New Information For Existing Related Service
S1008
Provision Replacement Service?
Y
N
S1014
Provision New Service
S1016
Proceed?
Y
N
S1018
Delete Service
S1011
To S324/S344

FIG. 10

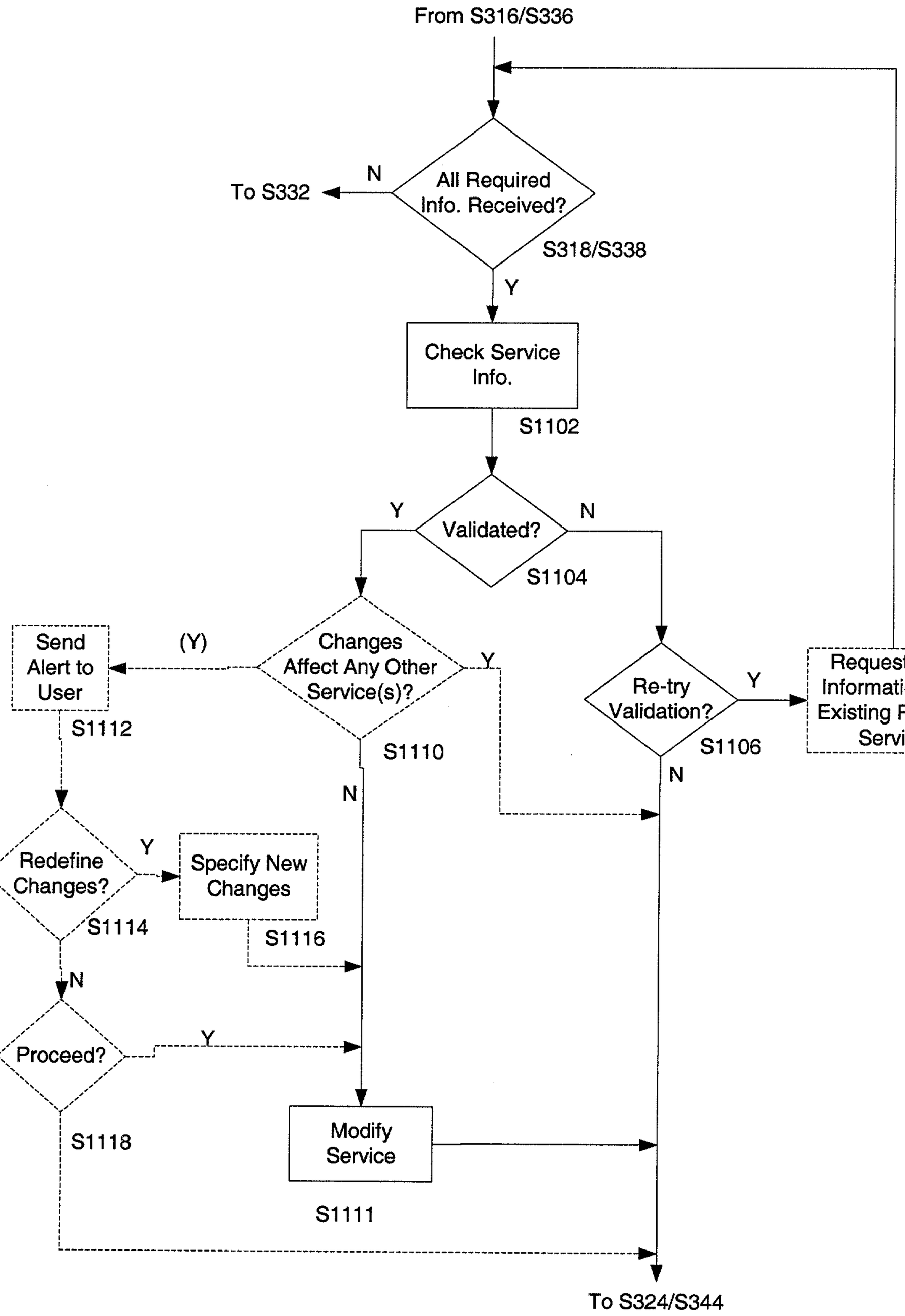

From S316/S336
All Required Info. Received?
N
To S332
Y
S318/S338
Check Service Info.
S1102
Validated?
Y
N
S1104
Changes Affect Any Other Service(s)?
(Y)
Y
Send Alert to User
S1112
S1110
Re-try Validation?
Y
S1106
Request New Information For Existing Related Service
S1108
N
N
Redefine Changes?
Y
Specify New Changes
S1114
S1116
N
Proceed?
Y
S1118
N
Modify Service
S1111
To S324/S344

FIG. 11

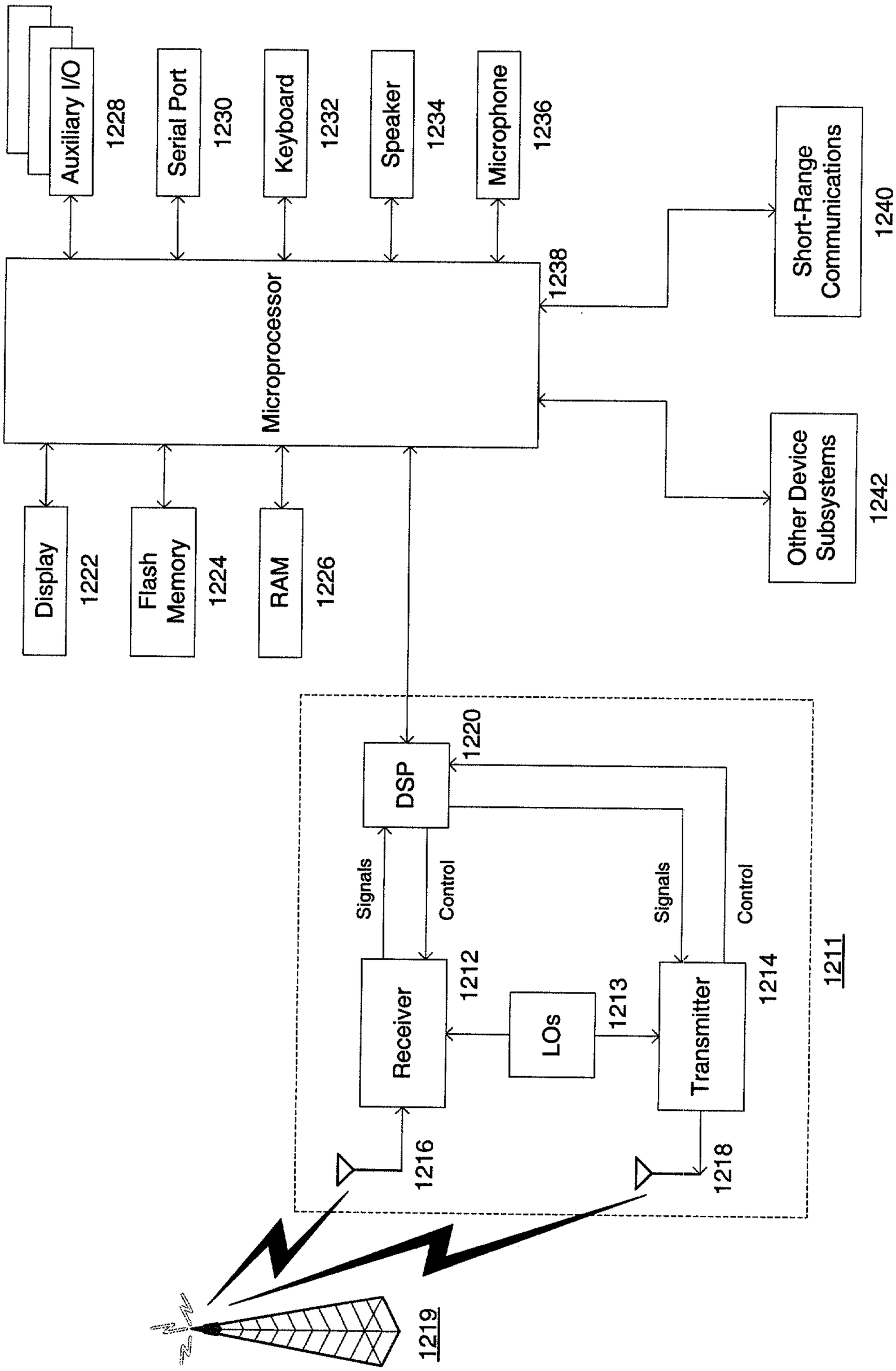
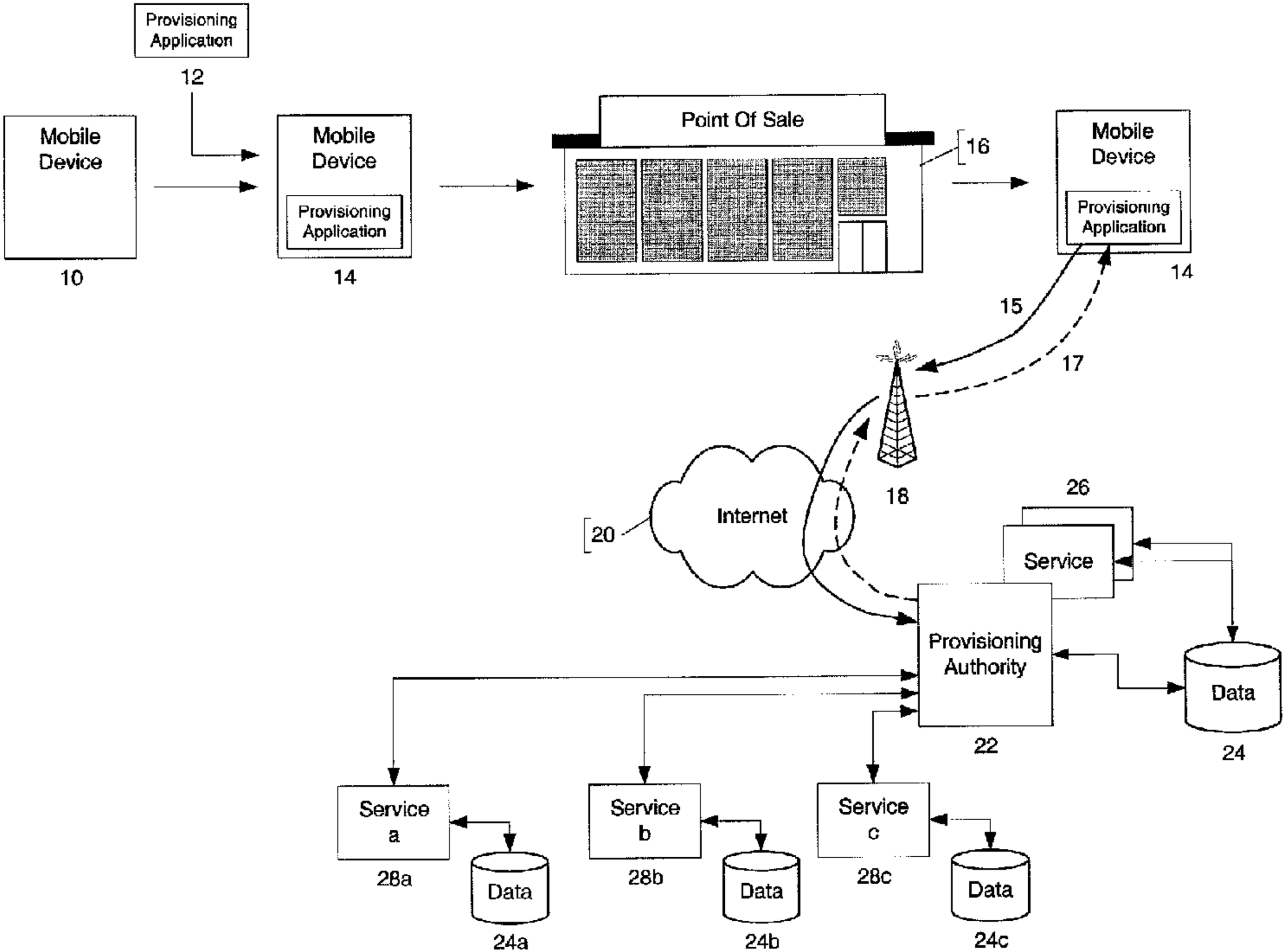

Auxiliary I/O
1228
Serial Port
1230
Keyboard
1232
Speaker
1234
Microphone
1236
Short-Range Communications
1240
1238
Microprocessor
Display
1222
Flash Memory
1224
RAM
1226
Other Device Subsystems
1242
1210
DSP
1220
Signals
Control
Signals
Control
Receiver
1212
LOs
1213
Transmitter
1214
1211
1216
1218
1219

FIG. 12


Provisioning Application
12
Mobile Device
10
Mobile Device
Provisioning Application
14
Point Of Sale
16
Mobile Device
Provisioning Application
14
15
17
18
Internet
20
26
Service
Provisioning Authority
22
Data
24
Service a
28a
Data
24a
Service b
28b
Data
24b
Service c
28c
Data
24c