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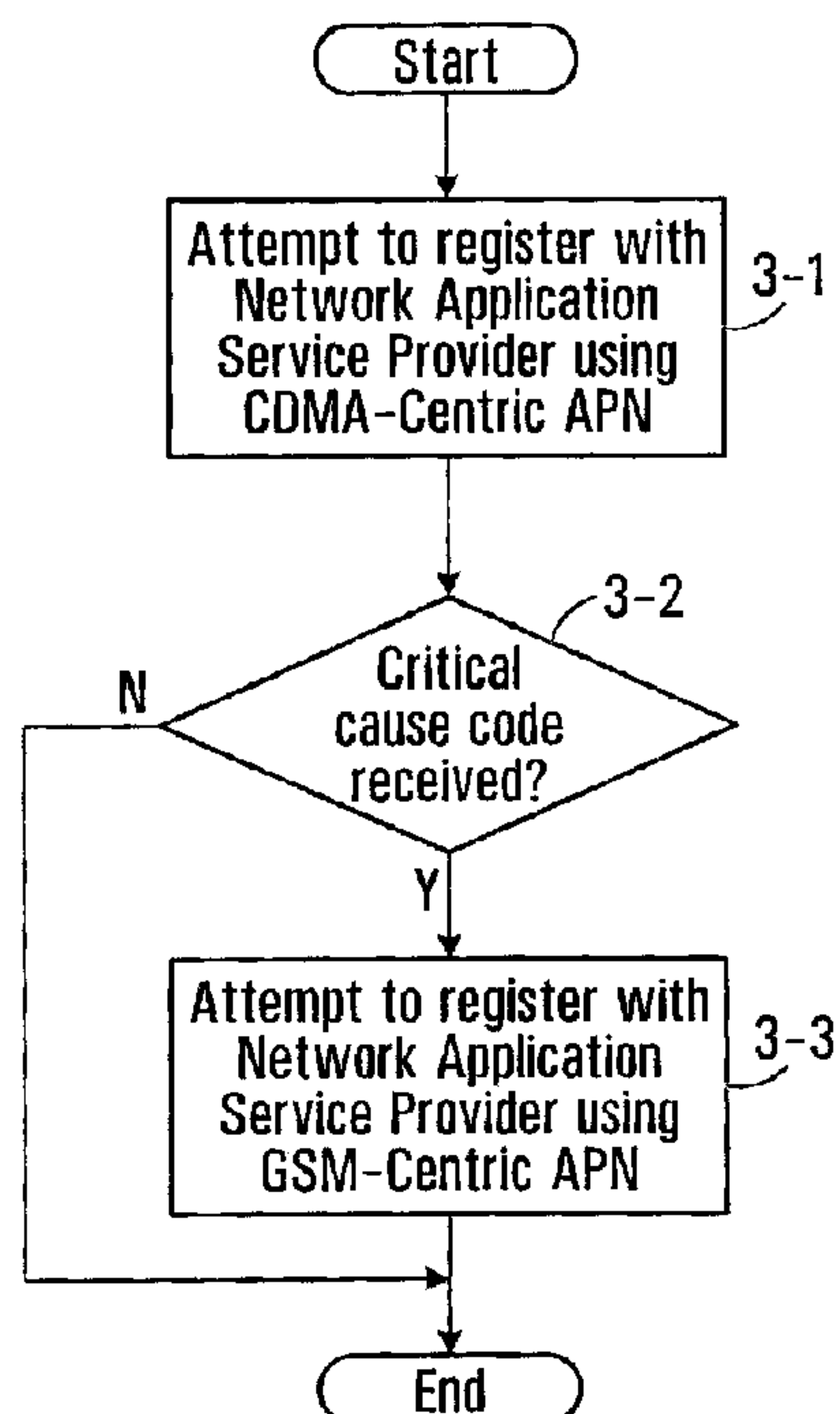
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(54) Titre : DISPOSITIF SANS FIL ET METHODE DE DETERMINATION DU NOM DE POINT D'ACCES (APN) A UTILISER

(54) Title: WIRELESS DEVICE AND METHOD FOR DETERMINING WHICH ACCESS POINT NAME (APN) TO USE



(57) Abrégé/Abstract:

Wireless devices and methods are provided for performing mobile discovery of an active data subscription. This involves a wireless device attempting to register using an APN that is one of a CDMA-centric APN and a GSM-centric APN. If that attempt fails, then the wireless device attempts to register using an APN that is the other of the CDMA-centric APN and the GSM-centric APN. In some cases the first APN attempted is always the CDMA-centric APN; in some cases the first APN attempted is a previously successfully used APN. For wireless devices with a data roaming enable/disable mechanism, the method can be executed while data roaming is disabled such that when data roaming is enabled, the proper APN to use will have been previously identified.

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ABSTRACT

Wireless devices and methods are provided for performing mobile discovery of an active data subscription. This involves a wireless device attempting to register using an APN that is one of a CDMA-centric APN and a GSM-centric APN. If that attempt fails, then the wireless device attempts to register using an APN that is the other of the CDMA-centric APN and the GSM-centric APN. In some cases the first APN attempted is always the CDMA-centric APN; in some cases the first APN attempted is a previously successfully used APN. For wireless devices with a data roaming enable/disable mechanism, the method can be executed while data roaming is disabled such that when data roaming is enabled, the proper APN to use will have been previously identified.

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WIRELESS DEVICE AND METHOD FOR DETERMINING WHICH ACCESS POINT NAME (APN) TO USE

Field of the Disclosure

This disclosure relates generally to wireless communication, and more
5 particularly to wireless devices with CDMA and GSM capability.

Background

To facilitate wider and more flexible roaming capabilities, wireless
devices are now being implemented with two or more radios that implement
respective different radio access technologies (RATs). A specific combination of
10 radio access technologies that might be included on a wireless device is CDMA (code
division multiple access) and GSM (Global System for Mobile communications). A
wireless device having more than one radio access technology is referred to herein
as a multi-RAT wireless device. A subscriber with such a device will typically have
access to services through one or both of the radio access technologies. The
15 particular radio access technologies that will be available vary on a geographical
basis, and will be dependent upon the network implementation of a subscriber's
home service provider and also on the network implementations of other networks
that might provide roaming access. The registration process is quite different for
CDMA data connectivity vs. GSM data connectivity.

20 As a specific example, the current Verizon network provides CDMA
coverage in North America, and provides only GSM coverage in Europe through
partner carriers there.

For CDMA purposes, wireless devices typically have identity
information stored in ROM (read only memory). For GSM purposes, wireless devices
25 are typically equipped with a SIM (subscriber identity module) card that has identity
information

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stored thereon. SIM cards are removable. It is possible for a subscriber to purchase a SIM card from a service provider other than the subscriber's home service provider, and to replace the SIM card provided by the subscriber's home service provider with the purchased SIM card. This can be done for example to allow a subscriber to have a local telephone number or to use local data services. Some users may prefer the convenience of being billed by and using the services of their home CDMA network, while others will prefer to use local services when travelling abroad. This system gives the user that choice by which SIM they place in the device.

GSM+CDMA-capable wireless devices are configured to use one or more different APNs (access point names) when performing access to a network application service provider that provides services such as push e-mail, weather forecasts, or financial market information. Use of an APN typically involves activating a PDP context with the APN. This information is stored in a database on the device called the registration host routing table. For a device that is a CDMA-centric device, meaning that its nominal operating mode in its home network is CDMA, one APN is an APN that will be referred to as a CDMA-centric APN. The CDMA-centric APN is used to obtain access to a network application service provider using CDMA registration procedures. This can be done while obtaining network access through a partner GSM network. When a wireless device registers with the network application using that APN, it does so using CDMA parameters stored in ROM. Another APN will be referred to as a GSM-centric APN. When the wireless device registers using the GSM-centric APN through a GSM network that is not a partner GSM network, it does so using GSM parameters and protocols.

Using the two APNs, the wireless devices have the ability to connect to a network application service provider

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through different paths. The first is to use the CDMA-centric APN that will allow it to communicate directly to the CDMA home network from a network providing roaming access through GSM, and to use CDMA parameters to register with the network application service provider. The second is to use the GSM-centric APN to register with the network application service provider using GSM parameters.

The first approach is illustrated in Figure 1. Shown is a wireless device 100 in communication with a GSM roaming network 106. The wireless device 100 is a CDMA-centric device in the sense that it uses CDMA when it accesses its CDMA home network 110. However, the wireless device 100 is also equipped with GSM capability for use when in a location that does not have a CDMA network. Also shown is a partner GSM network 107, an interworking and interoperability function (IIF) 132 connecting the partner GSM network 107 to the device's home CDMA network 110, and a network application gateway 112. The partner GSM network 107 has GPRS data infrastructure 114, this for example being the GGSN (Gateway GPRS Support Node) of the GSM network 107, that is associated with the CDMA-centric APN. The IIF 132 performs signalling and/or protocol conversions between the GSM 107 and the home CDMA network 110. Therefore, during data flow it can be seen that there is GPRS data in the GSM network 107 while there is CDMA data infrastructure 116 in the home CDMA network 110. The network application gateway 112 has a CDMA-centric role in dealing with CDMA-centric wireless devices such as wireless device 100. The wireless device 100 has a ROM (read only memory) 102 or other storage containing CDMA identification parameters, and has a SIM card SIM_A 104 containing GSM identification parameters associated with the partner GSM network 107. SIM_A is provided to the subscriber by the subscriber's home network provider and is configured to allow the subscriber to be able to use its partner GSM network.

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The partner GSM network 107 may be part of an overall set of networks of the same operator as the home CDMA network 110, or it may be operated by a different operator altogether. In practice, the home network provider usually obtains the SIM_A from the partner network and provides this to the subscriber. Partner GSM network 107 will recognize registration attempts by the wireless device using the CDMA-centric APN, but will not recognize registration attempts by the wireless device using the GSM-centric APN. More specifically, from the perspective of partner GSM network 107, the wireless device has a subscription to the CDMA-centric APN but not necessarily to the GSM-centric APN.

In operation, at the instant depicted, the access network 106 that is providing coverage to the wireless device 100 in its current location is a GSM roaming access network, meaning it is a GSM network, but it is not the device's home network, nor is it a partner GSM network to the device's home CDMA network 110. The wireless device 100 connects to the partner GSM network 107 through the GSM roaming network 106 using the information stored on the SIM_A 104. In order to access the network application gateway 112, a tunnel 108 from the wireless device 100 is created through the access network 106 and the partner GSM network 107 to the wireless device's CDMA home network 124. This is done using the CDMA-centric APN 114. From the perspective of the partner GSM network 107, the wireless device 100 has a subscription to the CDMA-centric APN. The home network 110 forwards data to and from the network application gateway 112. For the example of Figure 1, even though the device is connecting to a GSM access network 106, the wireless device 100 performs registration with the network application gateway using CDMA identification parameters which were stored in ROM 102. Note that should the wireless device attempt to register using the GSM-centric APN, the attempt will

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fail. The process of connecting through a GSM access network using CDMA parameters is described in the specification 3GPP2 X.S0034-0).

The second approach is illustrated in Figure 2.

5 Shown is the wireless device 100 (the same device as in Figure 1) in communication with a GSM access network 106. Also shown is a GSM network 118 that is not a partner network to the user's home CDMA network 110 of Figure 1. The GSM network 118 is shown in communication with network application gateway 126.

10 It is assumed that network application gateway 126 of Figure 2 and network application gateway 112 of Figure 1 are both being used to connect to the same network application, but the gateway of Figure 1 does so using CDMA parameters, whereas the gateway of Figure 2 does so using GSM parameters. That is to

15 say, for the purpose of interacting with wireless stations performing access through a GSM-centric APN, the network application gateway 126 is assumed to be GSM-centric. The wireless device 110 has ROM 102 containing CDMA parameters, and has SIM card SIM_B 105 containing GSM parameters that differ

20 from those on SIM card SIM_A 104. More specifically, the GSM parameters are associated with the GSM network 118 as opposed to the partner GSM network 107 of Figure 1. This presupposes that SIM_A of Figure 1 has been replaced with SIM_B of Figure 2. The GSM network 118 will recognize registration attempts by the

25 wireless device 100 using the GSM-centric APN, but will not recognize registration attempts by the wireless device using the CDMA-centric APN. More specifically, from the perspective of GSM network 118, the wireless device 100 has a subscription to the GSM-centric APN but not to the CDMA-centric APN.

30 In operation, at the instant depicted, the access network 106 that is providing coverage to the wireless device 100 in its current location is a GSM roaming access network, meaning it is a GSM network, but it is not the device's home

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network. The wireless device 100 connects to the GSM network 118 using the parameters stored on SIM_B 105. In addition, in order to access data services, a tunnel 122 from the wireless device 100 is created through the access
5 network 106 to GSM network 118 using the GSM-centric APN. The GSM network 118 recognizes the wireless device has a subscription to the GSM-centric APN. The GSM network 118 forwards data to and from the network application gateway 126. For the example of Figure 2, the wireless device 100 performs
10 registration with the network application gateway 126 using GSM identification parameters stored on SIM card SIM_B 105. Note that should the wireless device attempt to register using the CDMA-centric APN, the attempt will fail.

Summary of the Disclosure

15 According to one broad aspect, there is provided a method comprising: attempting to register with a first GGSN (Gateway GPRS Support Node) using a first APN (access point name) of a plurality of APNs; in the event of a failure of the attempt to register with the first GGSN using the first APN,
20 receiving feedback indicating failure of the attempt; and upon receipt of the feedback indicating failure of the attempt to register with the first GGSN using the first APN, attempting to register with another GGSN using another APN of the plurality of APNs; wherein the first APN of the plurality of APNs is one
25 of a CDMA-centric APN and a GSM-centric APN, and the another APN of the plurality of APNs is the other of the CDMA-centric APN and the GSM-centric APN, wherein the CDMA-centric APN is an APN that uses CDMA registration procedures, and the GSM-centric APN is an APN that uses GSM registration procedures.

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According to another broad aspect, there is provided a wireless device comprising: a plurality of wireless access radios each associated with a respective radio access technology; a medium having stored thereon instructions that, when executed by the wireless device, implement a function performing mobile discovery of an active data subscription and thereby determine an APN to use by: attempting to register with a first GGSN (Gateway GPRS Support Node) using a first APN of a plurality of APNs; in the event of a failure of the attempt to register with the first GGSN using the first APN, receiving feedback indicating failure of the attempt; and upon receipt of the feedback indicating failure of the attempt to register with the first GGSN using the first APN, attempting to register with another GGSN using another APN of the plurality of APNs; wherein the plurality of wireless access radios comprise a CDMA wireless access radio and a GSM wireless access radio; wherein the first APN is one of a CDMA-centric APN and a GSM-centric APN, wherein the CDMA-centric APN is an APN that uses CDMA registration procedures, and the GSM-centric APN is an APN that uses GSM registration procedures; and wherein the another APN of the plurality of APNs is the other of the CDMA-centric APN and the GSM-centric APN.

According to still another broad aspect, there is provided a computer readable medium having stored thereon computer executable instructions that, when executed by a computer, cause the computer to perform operations comprising: attempting to register with a first GGSN (Gateway GPRS Support Node) using a first APN of a plurality of APNs; in the event of a failure of the attempt to register with the first GGSN using

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the first APN, receiving feedback indicating failure of the attempt; and upon receipt of the feedback indicating failure of the attempt to register with the first GGSN using the first APN, attempting to register with another GGSN using another APN
5 of the plurality of APNs; wherein the first APN of the plurality of APNs is one of a CDMA-centric APN and a GSM-centric APN, and the another APN of the plurality of APNs is the other of the CDMA-centric APN and the GSM-centric APN, wherein the CDMA-centric APN is an APN that uses CDMA
10 registration procedures, and the GSM-centric APN is an APN that uses GSM registration procedures.

According to yet another broad aspect, there is provided a method comprising: attempting to register with a network application service provider using a first APN of a
15 plurality of APNs; in the event of a failure of the attempt to register using the first APN, receiving feedback indicating failure of the attempt; and upon receipt of feedback indicating failure of the attempt to register using the first APN, attempting to register with a network application service
20 provider using another APN of the plurality of APNs.

According to a further broad aspect, there is provided a wireless device comprising: a plurality of wireless access radios each associated with a respective radio access technology; a function performing mobile discovery of an active
25 data subscription and thereby determine an APN to use by: attempting to register with a network application service provider using a first APN of a plurality of APNs; in the event of a failure of the attempt to register using the first APN, receiving feedback indicating failure of the attempt; and upon

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receipt of feedback indicating failure of the attempt to register using the first APN, attempting to register with a network application service provider using the another of the plurality of APNs.

5 According to another broad aspect, there is provided a computer readable medium having computer executable instructions stored thereon for executing a method comprising: attempting to register with a network application service provider using a first APN of a plurality of APNs; in the event
10 of a failure of the attempt to register using the first APN, receiving feedback indicating failure of the attempt; and upon receipt of feedback indicating failure of the attempt to register using the first APN, attempting to register with a network application service provider using another of the
15 plurality of APNs.

Other aspects and features of the present disclosure will become apparent, to those ordinarily skilled in the art, upon review of the following description of the embodiments.

Brief Description of the Drawings

20 Embodiments will now be described with reference to the attached drawings in which:

Figure 1 is a block diagram of a network showing access to a network application gateway using a CDMA-centric APN;

25 Figure 2 is a block diagram of a network showing access to a network application gateway using a GSM-centric APN;

Figure 3 is a flowchart of a first method of establishing a PDP context;

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Figure 4 is a flowchart of a second method of establishing a PDP context;

Figure 5 is a flowchart of a method of maintaining an identification of a correct APN to use while data roaming is disabled;

Figures 6 and 7 are block diagrams of wireless devices;

Figure 8 is a flowchart of another method of establishing a PDP context; and

Figure 9 is a flowchart of another method of establishing a PDP context.

Description of Embodiments

When a wireless device is on a partner GSM network, the wireless device will use the CDMA-centric APN since it is a CDMA-centric device. However, when the user of the wireless device purchases another SIM card, for example while traveling, the operator that provided that SIM card can assign the wireless device to the GSM-centric APN. SIM cards do not include a mechanism for specifying what APN the wireless device is subscribed to. When the wireless device sees that it is attached to a GSM network and knows that it is roaming, it does not know whether its home network is a CDMA network or a GSM network. It has two identities, a GSM identity and a CDMA identity. When it registers with the network application gateway it must use the identity which is associated with its home network in order to receive the correct services that have been provisioned based on its identity on its home network.

Referring to Figure 3, shown is a flowchart of a first method of performing mobile discovery of an active data subscription. The method begins at step 3-1 with an attempt by

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a wireless device to register with a network application service provider using the wireless device's CDMA-centric APN that might for example be stored in the Host Routing Table on the device. At step 3-2, if no critical cause code is received
5 (for example the context is established successfully, or fails with a non-critical cause code), then the method ends. On the other hand, if at step 3-2, a critical cause code is received (yes path), then at step 3-3 the wireless device attempts to register with the network application service provider using
10 the wireless device's GSM-centric APN.

Examples of critical cause codes that can be used to determine that the attempt to register failed include:

- 27 - Unknown or missing APN;
- 30 - Activation rejected by GGSN;
- 15 33 - Requested service option not subscribed.

See for example "3rd Generation Partnership Project 2 3GPP2", 3GPP2 X.S0034-0, Version 1.0, April 2005.

More generally, after attempting to register context in step 3-1, any feedback from the network that can be used by
20 the wireless device to determine that the attempt failed can be used to trigger the subsequent attempt using the other APN in step 3-3.

The method of Figure 3 may be implemented when the wireless device is powered on and/or when a new SIM card is
25 installed in the wireless device. The Figure 3 embodiment assumes that the first APN that is attempted is the CDMA-centric APN, and this is followed by an attempt using the GSM-centric APN. In another embodiment (not shown), the first APN is one of the CDMA-centric APN and the GSM-centric APN, and the
30 second APN is the other of the CDMA-centric APN and the GSM-

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centric APN. Note that the first APN that is attempted is implementation specific. The embodiment of Figure 4 described below is a specific case of this where the first APN attempted is a previously successfully used APN.

5 Referring to Figure 4, shown is a flowchart of a
another method of performing mobile discovery of an active data
subscription. The method begins at step 4-1 with an attempt by
a wireless device to register with the network application
service provider using the previously successfully used APN.
10 The previously successfully used APN may for example be stored
in non-volatile memory. This may be the CDMA-centric APN or
the GSM-centric APN. At step 4-2, if no critical cause code
(or other implementation specific feedback) is received (no
path), then the method ends. On the other hand, if at step 4-
15 2, a critical cause code (or other implementation specific
feedback) is received (yes path), then at step 4-3 the wireless
device attempts to register with the network application
service provider using the APN that is other than the
previously successfully used APN. Assuming this is successful,
20 at step 4-4 the wireless device updates the information in non-
volatile memory that identifies the previously successfully
used APN.

The method of Figure 4 may be implemented when the wireless device is powered on.

25 In some embodiments, wireless devices are equipped
with the capability to restrict/disable data roaming. This can
be used to disable data roaming while in a geographical area
associated with very high cost for example. This can take the
form of a feature selected through a graphical user interface
30 on a wireless device for example. It can be referred to as a
data roaming guard. While the data roaming guard is on, data
roaming is disabled, whereas while the data roaming guard is

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not on, data roaming is enabled. Another embodiment provides a mechanism of maintaining knowledge of the correct APN to use notwithstanding whether the data roaming guard is on. In the event the user turns the data roaming guard off, the wireless device will then immediately know the correct APN to use, and delays in accessing the network may be reduced.

Referring to Figure 5, the method begins at step 5-1 with determining which APN to use while the data roaming is disabled. This can be done, for example using one of the methods of Figure 3 and 4, but without sending any data, thereby minimizing cost to the subscriber. This may result in the establishment of a PDP context using the APN. At step 5-2, after discovering correct APN, the PDP context thus established may be torn down. At step 5-3, the APN thus identified is stored in non-volatile memory. Steps 5-1, 5-2 and 5-3 are repeated each time the wireless device powers up and/or each time the SIM card is changed. At step 5-4, upon enabling data roaming, registration is attempted using the previously identified APN that is stored in non-volatile memory.

The embodiments described have focussed on applications where there are two APNs, referred to as so-called the GSM-centric APN and the CDMA-centric APN. Methods and devices have been described for selecting which of these to use. In another embodiment, similar methods and devices are provided that have the more general application of selecting which one of a set of a least two APNs to use, the at least two APNs not necessarily being or including the GSM-centric APN and/or the CDMA-centric APN.

Referring to Figure 8, shown is a flowchart of such a method of performing mobile discovery of an active data subscription. The method begins at step 8-1 with an attempt by a wireless device to register with a network application

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service provider using a first APN that might for example be stored in the Host Routing Table on the device. At step 8-2, if no critical cause code is received (for example the context is established successfully, or fails with a non-critical cause code), then the method ends. On the other hand, if at step 8-2, a critical cause code is received (yes path), then if there is another APN to try (yes path step 8-3) then the method returns to step 8-1 for the wireless device to attempt to register with the network application service provider using a next APN. The loop of steps 8-1,8-2,8-3 is repeated until either success is achieved, or there are no other APNs to try.

More generally, after attempting to register context in step 8-1, any feedback from the network that can be used by the wireless device to determine that the attempt failed can be used to trigger the subsequent attempt using the other APN.

Referring to Figure 9, shown is a flowchart of another method of performing mobile discovery of an active data subscription. The method begins at step 9-1 with an attempt by a wireless device to register with the network application service provider using the previously successfully used APN. The previously successfully used APN may for example be stored in non-volatile memory. At step 9-2, if no critical cause code (or other implementation specific feedback) is received (no path), then the method ends. On the other hand, if at step 9-2, a critical cause code (or other implementation specific feedback) is received (yes path), then at step 9-3 the wireless device attempts to register with the network application service provider using the APN that is other than the previously successfully used APN. Assuming this is successful, at step 9-4 the wireless device updates the information in non-volatile memory that identifies the previously successfully used APN. There may be additional iterations of steps 9-2 and

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9-3 until success is achieved, or there are no more APNs to try.

The method of Figure 5 can also be applied in this more general context. In this case, the so-called "previously identified APN" is simply any one of the multiple APNs available to the wireless device that was previously identified as being appropriate to use.

Referring now to Figure 6, shown is a block diagram of a wireless device 10-1 that can implement one or more of the previously described methods. The wireless device 10-1 has a CDMA wireless access radio 16-1, a GSM wireless access radio 18-1, a processor 17-1, and a function performing mobile discovery of an active data subscription 15. More generally, the wireless device has a plurality of wireless access radios, each implementing a respective radio access technology. GSM and CDMA are but two specific examples. The wireless device 10-1 also has a non-volatile memory, SIM 20, and data roaming enable/disable mechanism 22. The wireless device 10-1 may have other components, but they are not shown for sake of simplicity. More generally, in place of SIM 20, any smart card containing a subscriber identity application and/or subscriber identity parameters can be employed.

In operation, the function 15 in the wireless device 10-1 coordinates determination of the active data subscription, by determining a current APN to use for the device. This can be done using any of the methods described above. The function 15 may be implemented in software, hardware, firmware, or a combination of software, hardware and firmware. Non-volatile memory 19-1 can be used to store CDMA parameters; it can also be used to store a previously successfully used APN. SIM 20 stores GSM parameters. The data roaming enable/disable mechanism 22 allows a subscriber to selectively enable or

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disable data roaming. While data roaming is disabled, there is no data communications to/from the device.

Another broad aspect provides a computer readable medium having instructions stored thereon for implementing function 15, and more generally for implementing any of the methods described herein. Of course the computer readable medium may not be capable of completely executing the method on its own, since interaction with other components on the wireless device such as the radios, antenna(s) etc. is necessary. In such a case, the instructions on the computer readable medium are still driving the method.

Referring now to Fig. 7, shown is a block diagram of another wireless device 700 that may implement one or more of the previously described methods. It is to be understood that the wireless device 700 is shown with very specific details for example purposes only.

A processing device (a microprocessor 728) is shown schematically as coupled between a keyboard 714 and a display 726. The microprocessor 728 controls operation of the display 726, as well as overall operation of the wireless device 700, in response to actuation of keys on the keyboard 714 by a user.

The wireless device 700 has a housing that may be elongated vertically, or may take on other sizes and shapes (including clamshell housing structures). The keyboard 714 may include a mode selection key, or other hardware or software for switching between text entry and telephony entry.

In addition to the microprocessor 728, other parts of the wireless device 700 are shown schematically. These include: a communications subsystem 770; a short-range communications subsystem 702; the keyboard 714 and the display 726, along with other input/output devices including a set of

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LEDS 704, a set of auxiliary I/O devices 706, a serial port 708, a speaker 711 and a microphone 712; as well as memory devices including a flash memory 716 and a Random Access Memory (RAM) 718; and various other device subsystems 720. The wireless device 700 may have a battery 721 to power the active elements of the wireless device 700. The wireless device 700 is in some embodiments a two-way radio frequency (RF) communication device having voice and data communication capabilities. In addition, the wireless device 700 in some embodiments has the capability to communicate with other computer systems via the Internet.

Operating system software executed by the microprocessor 728 is in some embodiments stored in a persistent store, such as the flash memory 716, but may be stored in other types of memory devices, such as a read only memory (ROM) or similar storage element. In addition, system software, specific device applications, or parts thereof, may be temporarily loaded into a volatile store, such as the RAM 718. Communication signals received by the wireless device 700 may also be stored to the RAM 718.

The microprocessor 728, in addition to its operating system functions, enables execution of software applications on the wireless device 700. A predetermined set of software applications that control basic device operations, such as a voice communications module 730A and a data communications module 730B, may be installed on the wireless device 700 during manufacture. In addition, a personal information manager (PIM) application module 730C may also be installed on the wireless device 700 during manufacture. The PIM application is in some embodiments capable of organizing and managing data items, such as e-mail, calendar events, voice mails, appointments, and task items. The PIM application is also in some embodiments capable of sending and receiving data items via a wireless network 710.

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In some embodiments, the data items managed by the PIM application are seamlessly integrated, synchronized and updated via the wireless network 710 with the device user's corresponding data items stored or associated with a host computer system. As well, additional software modules, illustrated as other software module 730N, may be installed during manufacture.

Communication functions, including data and voice communications, are performed through the communication subsystem 770, and possibly through the short-range communications subsystem 702. The communication subsystem 770 includes a receiver 750, a transmitter 752 and one or more antennas, illustrated as a receive antenna 754 and a transmit antenna 756. In addition, the communication subsystem 770 also includes a processing module, such as a digital signal processor (DSP) 758, and local oscillators (LOs) 760. The specific design and implementation of the communication subsystem 770 is dependent upon the communication network in which the wireless device 700 is intended to operate. For example, the communication subsystem 770 of the wireless device 700 may be designed to operate with the Mobitex™, DataTAC™ or General Packet Radio Service (GPRS) mobile data communication networks and also designed to operate with any of a variety of voice communication networks, such as Advanced Mobile Phone Service (AMPS), Time Division Multiple Access (TDMA), Code Division Multiple Access CDMA, CDMA 1xEuDO, OFDM (orthogonal frequency division multiplexing), Personal Communications Service (PCS), Global System for Mobile Communications (GSM), etc. Other types of data and voice networks, both separate and integrated, may also be utilized with the wireless device 700.

Network access may vary depending upon the type of communication system. For example, in the Mobitex™ and DataTAC™ networks, wireless devices are registered on the

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network using a unique Personal Identification Number (PIN) associated with each device. In GPRS networks, however, network access is typically associated with a subscriber or user of a device. A GPRS device therefore typically has a
5 subscriber identity module, commonly referred to as a Subscriber Identity Module (SIM) card, in order to operate on a GPRS network.

When network registration or activation procedures have been completed, the wireless device 700 may send and
10 receive communication signals over the communication network 710. Signals received from the communication network 710 by the receive antenna 754 are routed to the receiver 750, which provides for signal amplification, frequency down conversion, filtering, channel selection, etc., and may also provide analog
15 to digital conversion. Analog-to-digital conversion of the received signal allows the DSP 758 to perform more complex communication functions, such as demodulation and decoding. In a similar manner, signals to be transmitted to the network 710 are processed (e.g., modulated and encoded) by the DSP 758 and
20 are then provided to the transmitter 752 for digital to analog conversion, frequency up conversion, filtering, amplification and transmission to the communication network 710 (or networks) via the transmit antenna 756.

In addition to processing communication signals, the
25 DSP 758 provides for control of the receiver 750 and the transmitter 752. For example, gains applied to communication signals in the receiver 750 and the transmitter 752 may be adaptively controlled through automatic gain control algorithms implemented in the DSP 758.

30 In a data communication mode, a received signal, such as a text message or web page download, is processed by the communication subsystem 770 and is input to the microprocessor

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728. The received signal is then further processed by the microprocessor 728 for an output to the display 726, or alternatively to some other auxiliary I/O devices 706. A device user may also compose data items, such as e-mail messages, using the keyboard 714 and/or some other auxiliary I/O device 706, such as a touchpad, a rocker switch, a thumb-wheel, or some other type of input device. The composed data items may then be transmitted over the communication network 710 via the communication subsystem 770.

10 In a voice communication mode, overall operation of the device is substantially similar to the data communication mode, except that received signals are output to a speaker 711, and signals for transmission are generated by a microphone 712. Alternative voice or audio I/O subsystems, such as a voice message recording subsystem, may also be implemented on the wireless device 700. In addition, the display 726 may also be utilized in voice communication mode, for example, to display the identity of a calling party, the duration of a voice call, or other voice call related information.

20 The short-range communications subsystem 702 enables communication between the wireless device 700 and other proximate systems or devices, which need not necessarily be similar devices. For example, the short-range communications subsystem 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.

30 In Figure 7, microprocessor 728, RAM 718, communication sub-system 770, display 726, flash memory 716, voice module and data module can cooperate to implement one or more of the methods described herein. More generally, the

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implementation particulars will depend on a given wireless device configuration.

Numerous modifications and variations of the illustrated embodiments are possible in light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the disclosure may be practiced otherwise than as specifically described with respect to the figures.

CLAIMS:

1. A method in a wireless device having a plurality of wireless access radios, each associated with a respective radio access technology (RAT), the method comprising:

attempting to register with a first GGSN (Gateway GPRS Support Node) using a first APN (access point name) of a plurality of APNs;

in the event of a failure of the attempt to register with the first GGSN using the first APN, receiving a critical cause code indicating failure of the attempt; and

upon receipt of a critical cause code indicating failure of the attempt to register with the first GGSN using the first APN, attempting to register with another GGSN using another APN of the plurality of APNs;

wherein the first APN of the plurality of APNs is one of a CDMA-centric APN and a GSM-centric APN, and the another APN of the plurality of APNs is the other of the CDMA-centric APN and the GSM-centric APN, wherein the CDMA-centric APN is an APN that uses CDMA registration procedures, and the GSM-centric APN is an APN that uses GSM registration procedures.

2. The method of claim 1, wherein the first APN represents an IP network of a first network application service provider and the another APN represents an IP network of a second application service provider.

3. The method of claim 1 or claim 2 wherein attempting to register with the first GGSN using the first APN is always performed using the CDMA-centric APN.

4. The method of claim 1 or claim 2 further comprising:
storing information identifying a previously
successfully used APN;

wherein attempting to register with the first GGSN
using the first APN is always performed using the previously
successfully used APN.

5. The method of claim 1 wherein receiving the critical
cause code comprises receiving one of:

27 - Unknown or missing APN;

30 - Activation rejected by GGSN; and

33 - Requested service option not subscribed.

6. The method of any one of claims 1 to 5, the method
being performed in a wireless device and further comprising
executing the method each time a smart card containing a
subscriber identity application and/or subscriber identity
parameters is changed in the wireless device.

7. The method of any one of claims 1 to 5, the method
being performed in a wireless device and further comprising
executing the method each time the wireless device is powered
on.

8. The method of any one of claims 1 to 7 wherein:

said attempting to register with the first GGSN using the first APN of the plurality of APNs further comprises attempting to register with a network application service provider using the first APN of the plurality of APNs;

and wherein said attempting to register with the another GGSN using the another APN of the plurality of APNs further comprises attempting to register with another network application service provider using the another APN of the plurality of APNs.

9. A method comprising:

while data roaming is disabled, performing the method of any one of claims 1 to 3;

storing information identifying one of the plurality of APNs as a successfully used APN in non-volatile memory; and

upon enabling data roaming, using the APN identified by the stored information.

10. The method of claim 9 further comprising tearing down a PDP (packet data protocol) context that was established while data roaming is disabled.

11. The method of claim 9 or claim 10 wherein while data roaming is disabled no data is transmitted.

12. A wireless device comprising:

a plurality of wireless access radios each associated with a respective radio access technology;

a medium having stored thereon instructions that, when executed by the wireless device, implement a function performing mobile discovery of an active data subscription and thereby determine an APN to use by:

attempting to register with a first GGSN (Gateway GPRS Support Node) using a first APN of a plurality of APNs;

in the event of a failure of the attempt to register with the first GGSN using the first APN, receiving a critical cause code indicating failure of the attempt; and

upon receipt of a critical cause code indicating failure of the attempt to register with the first GGSN using the first APN, attempting to register with another GGSN using another APN of the plurality of APNs;

wherein the plurality of wireless access radios comprise a CDMA wireless access radio and a GSM wireless access radio;

wherein the first APN is one of a CDMA-centric APN and a GSM-centric APN, wherein the CDMA-centric APN is an APN that uses CDMA registration procedures, and the GSM-centric APN is an APN that uses GSM registration procedures; and

wherein the another APN of the plurality of APNs is the other of the CDMA-centric APN and the GSM-centric APN.

13. The wireless device of claim 12 wherein the wireless device further comprises a smart card containing a subscriber identity application and/or subscriber identity parameters.

14. The wireless device of claim 12 wherein the function performing mobile discovery of an active data subscription by attempting to register with a first GGSN using a first APN is always performed using a CDMA-centric APN.

15. The wireless device of claim 12 or claim 13 further comprising:

a non-volatile memory;

wherein the function performing mobile discovery of an active data subscription stores information identifying a previously successfully used APN in the non-volatile memory;

wherein the function performing mobile discovery of an active data subscription by attempting to register with the first GGSN using the first APN is always performed using the previously successfully used APN.

16. The wireless device of claim 12 wherein the critical cause code is one of:

27 - Unknown or missing APN;

30 - Activation rejected by GGSN; and

33 - Requested service option not subscribed.

17. The wireless device of any one of claims 12 to 16 that determines an APN to use each time a smart card containing a subscriber identity application and/or subscriber identity parameters is changed in the wireless device.

18. The wireless device of any one of claims 12 to 17 that determines an APN to use each time the wireless device is powered on.

19. The wireless device of claim 12 or claim 13 further comprising:

a data roam enable/disable mechanism allowing a user to selectively enable and disable data roaming;

the function performing mobile discovery of an active data subscription determining the APN to use while data roaming is disabled and storing information identifying one of the plurality of APNs as a successfully used APN in non-volatile memory;

wherein upon enabling data roaming, the wireless device uses the APN identified by the stored information.

20. The wireless device of claim 19 wherein the device tears down a PDP (packet data protocol) context that was established while data roaming is disabled.

21. The wireless device of claim 19 or claim 20 wherein while data roaming is disabled no data is transmitted.

22. The wireless device of any one of claims 12 to 21 wherein:

said attempting to register with the first GGSN using the first APN of a plurality of APNs further comprises attempting to register with a network application service provider using the first APN of the plurality of APNs;

and wherein said attempting to register with the another GGSN using the another APN of the plurality of APNs further comprises attempting to register with another network application service provider using the another APN of the plurality of APNs.

23. The wireless device of any one of claims 12 to 22, wherein the first APN represents an IP network of a first network application service provider and the another APN represents an IP network of a second application service provider.

24. A computer readable medium having stored thereon computer executable instructions that, when executed by a computer, cause the computer to perform operations comprising:

attempting to register with a first GGSN (Gateway GPRS Support Node) using a first APN of a plurality of APNs;

in the event of a failure of the attempt to register with the first GGSN using the first APN, receiving a critical cause code indicating failure of the attempt; and

upon receipt of a critical cause code indicating failure of the attempt to register with the first GGSN using the first APN, attempting to register with another GGSN using another APN of the plurality of APNs;

wherein the first APN of the plurality of APNs is one of a CDMA-centric APN and a GSM-centric APN, and the another

APN of the plurality of APNs is the other of the CDMA-centric APN and the GSM-centric APN, wherein the CDMA-centric APN is an APN that uses CDMA registration procedures, and the GSM-centric APN is an APN that uses GSM registration procedures.

25. The computer readable medium of claim 24 wherein:

said attempting to register with the first GGSN using the first APN of the plurality of APNs further comprises attempting to register with a network application service provider using the first APN of the plurality of APNs;

and wherein said attempting to register with the another GGSN using the another APN of the plurality of APNs further comprises attempting to register with another network application service provider using the another APN of the plurality of APNs.

26. The computer readable medium of claim 24 or claim 25, wherein the first APN represents an IP network of a first network application service provider and the another APN represents an IP network of a second application service provider.

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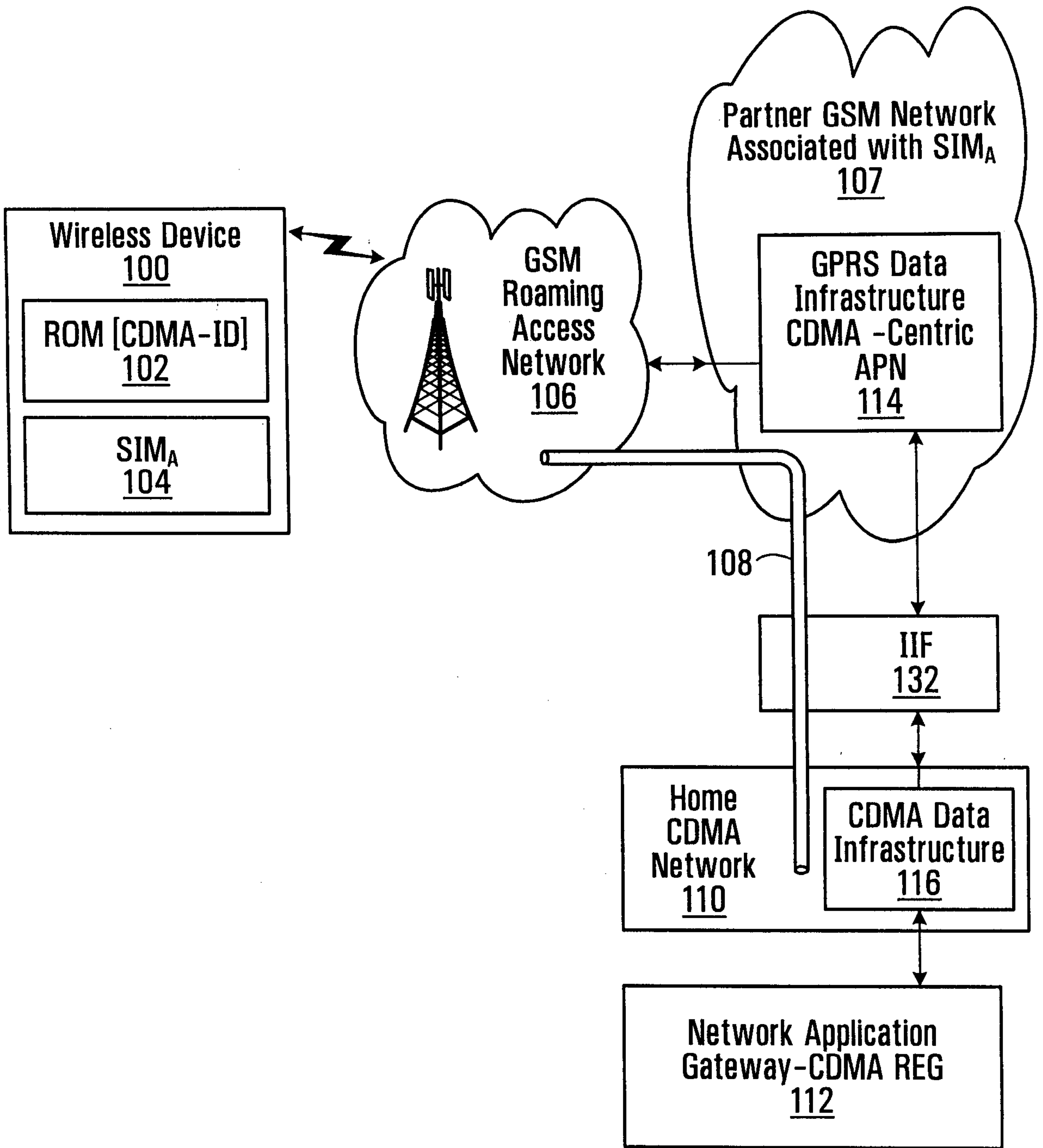


FIG. 1
(Prior Art)

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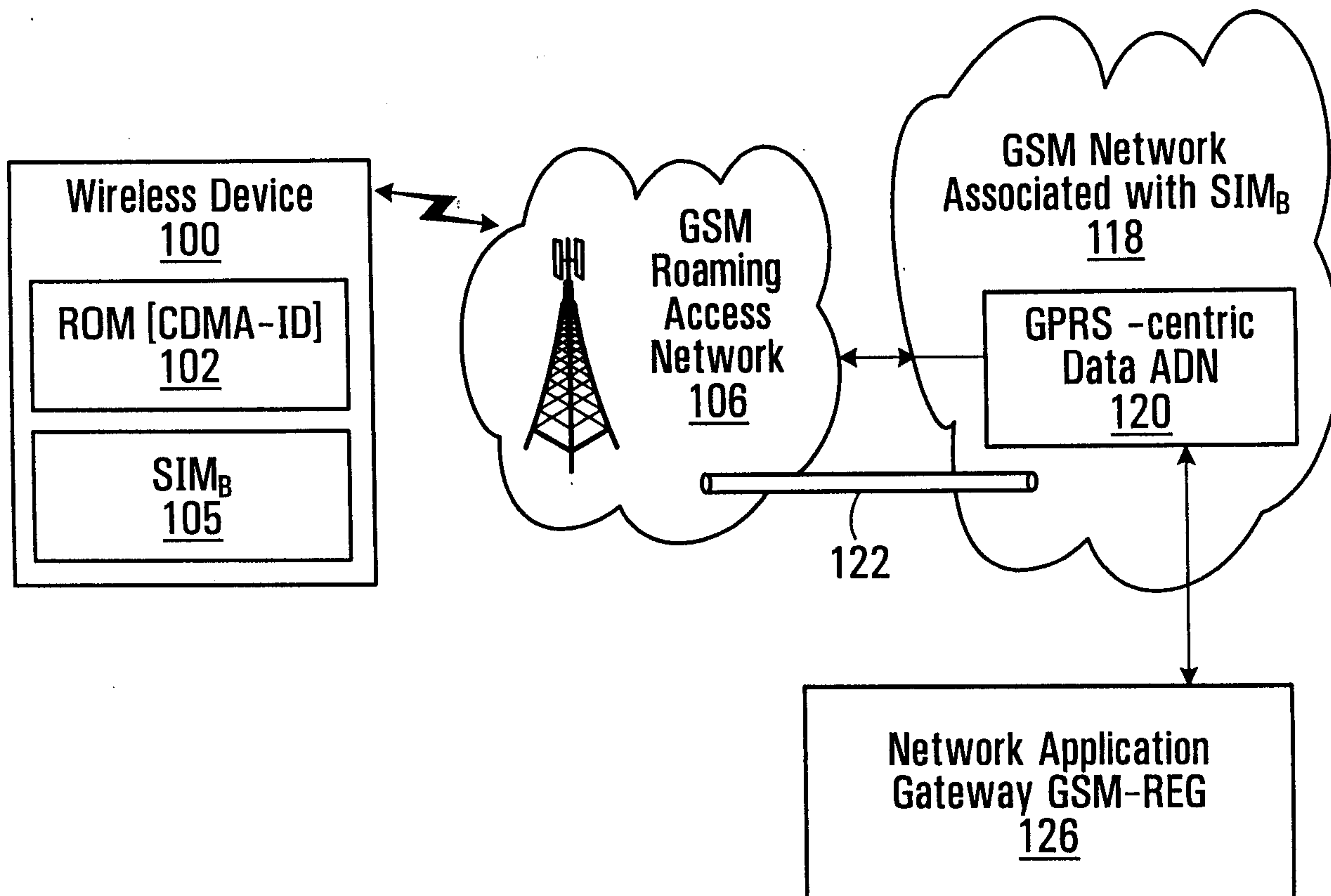


FIG. 2
(Prior Art)

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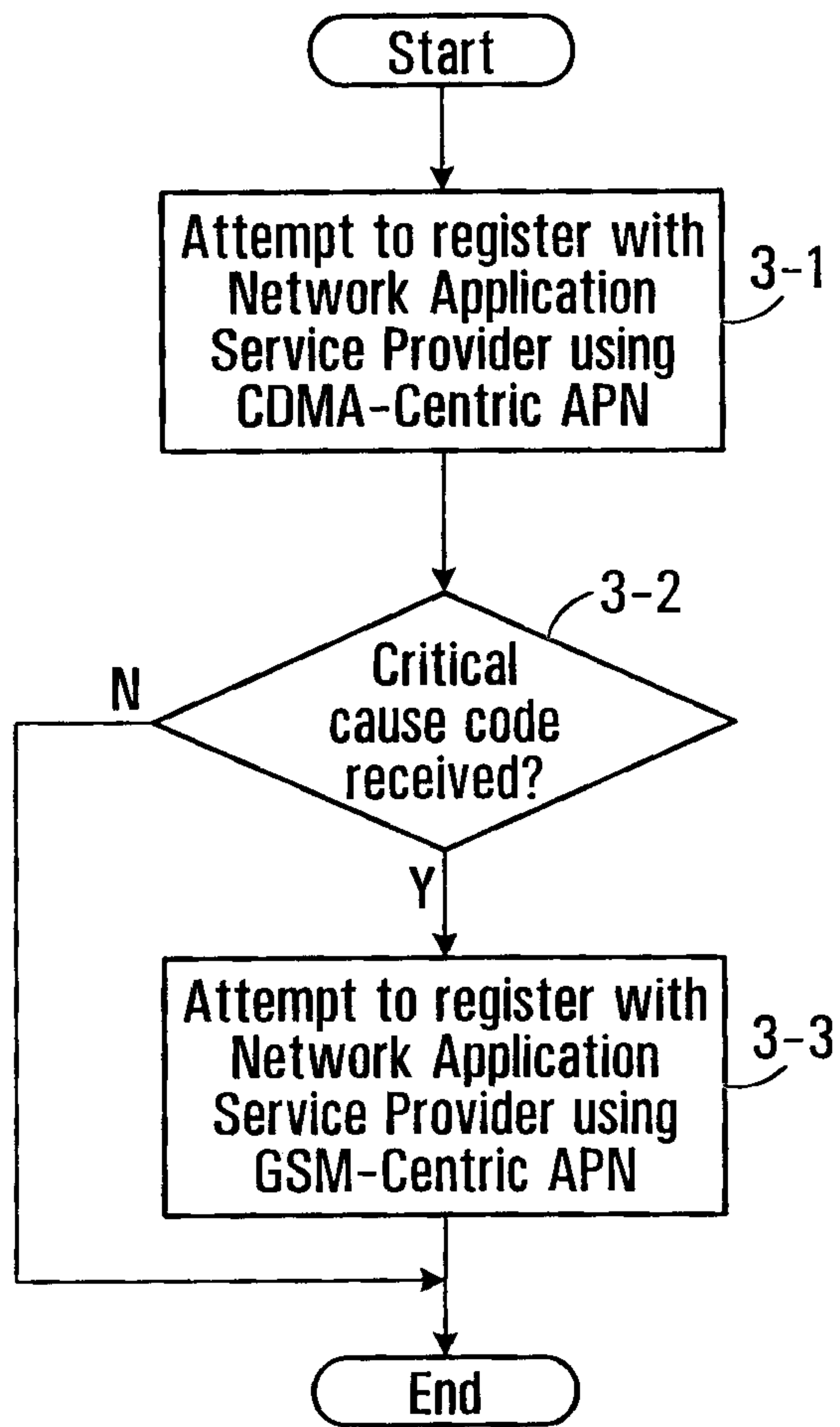


FIG. 3

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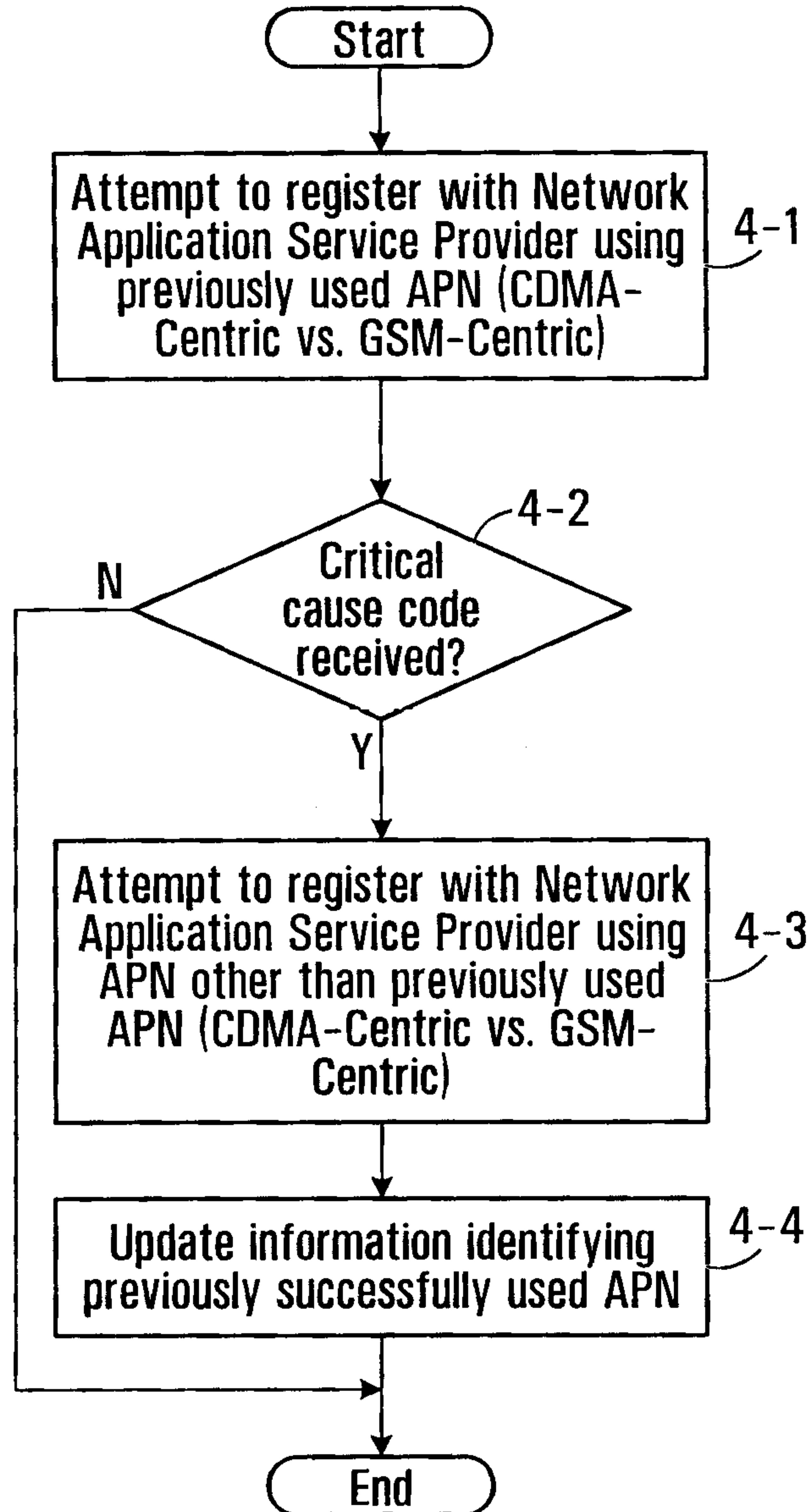
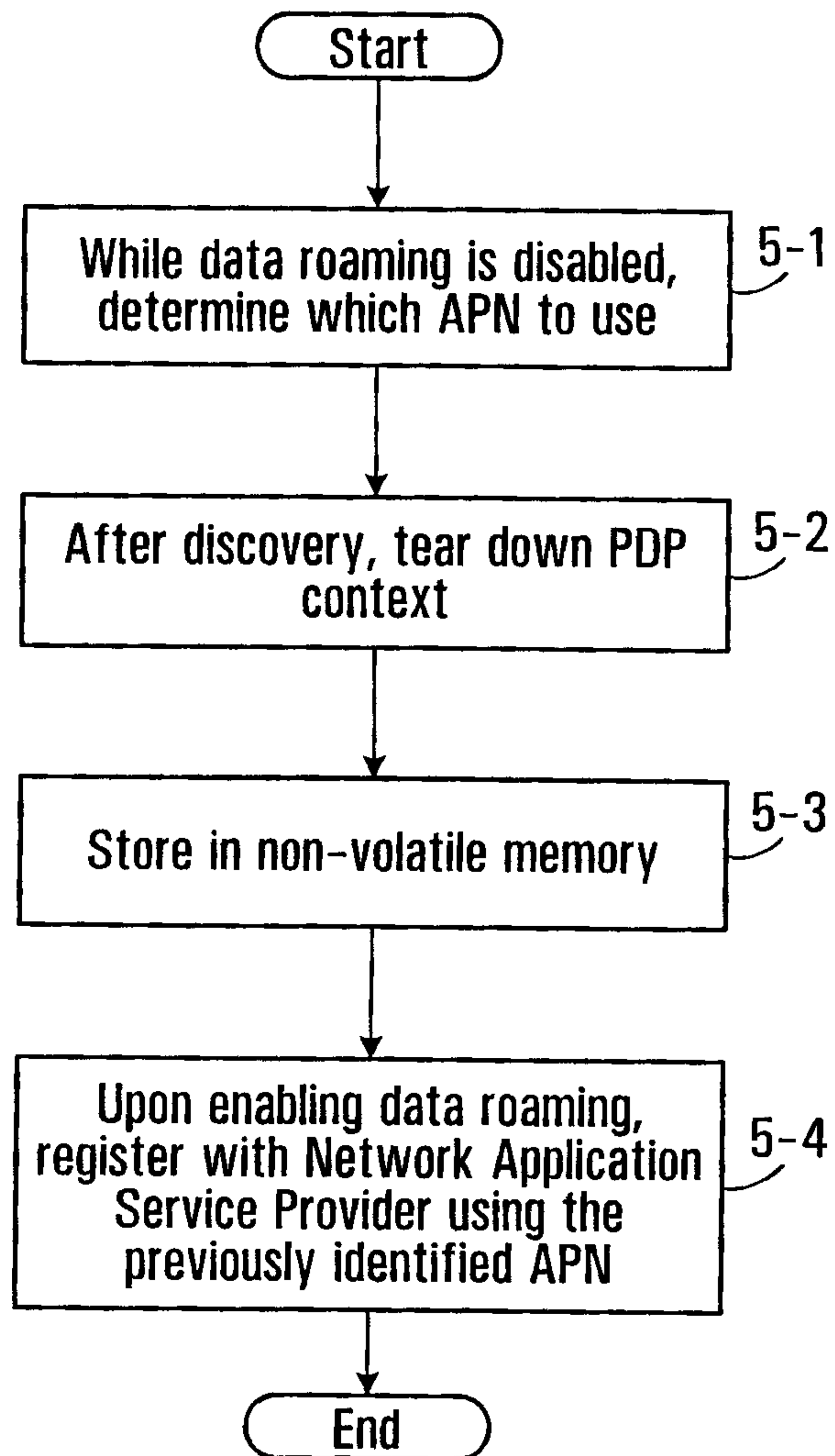


FIG. 4

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**FIG. 5**

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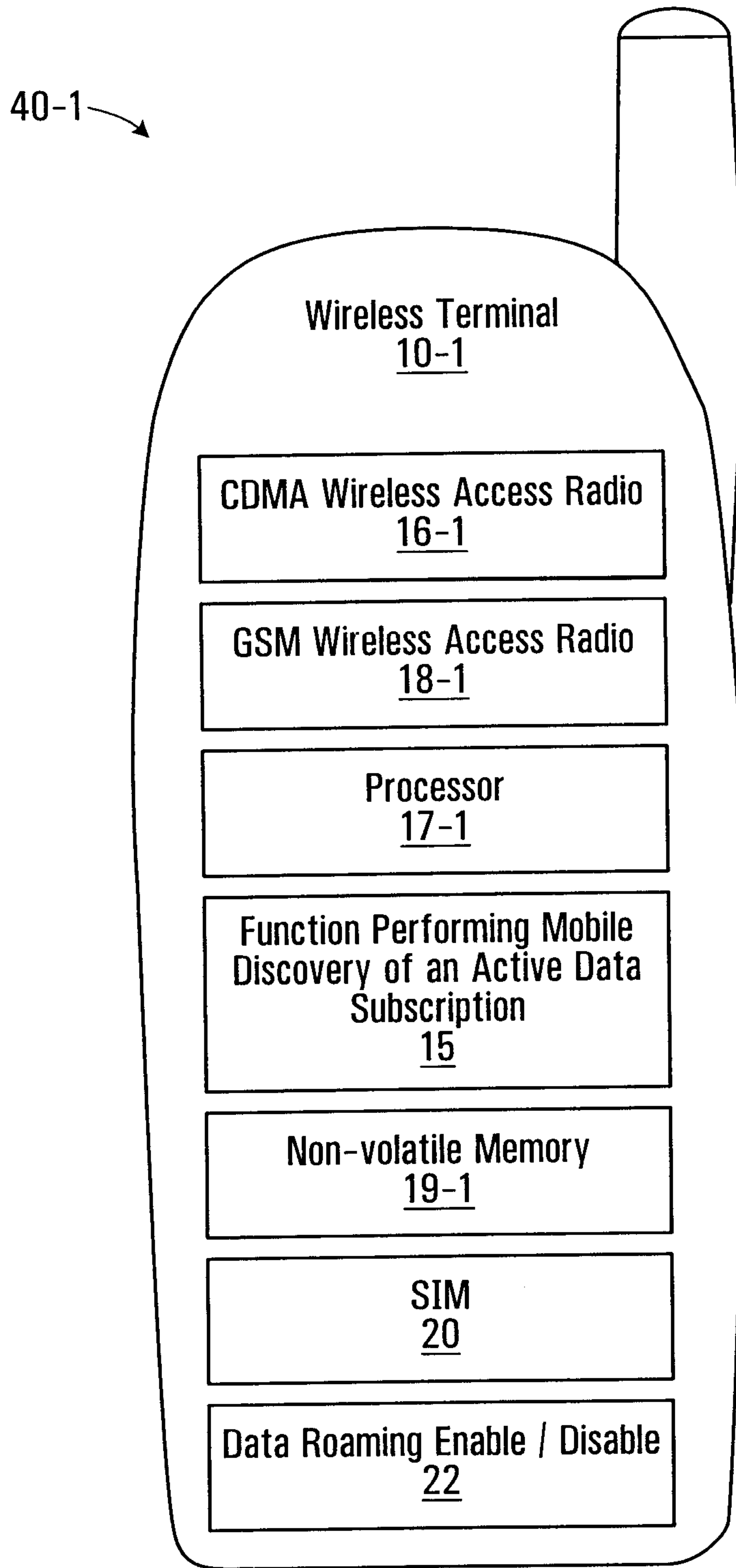


FIG. 6

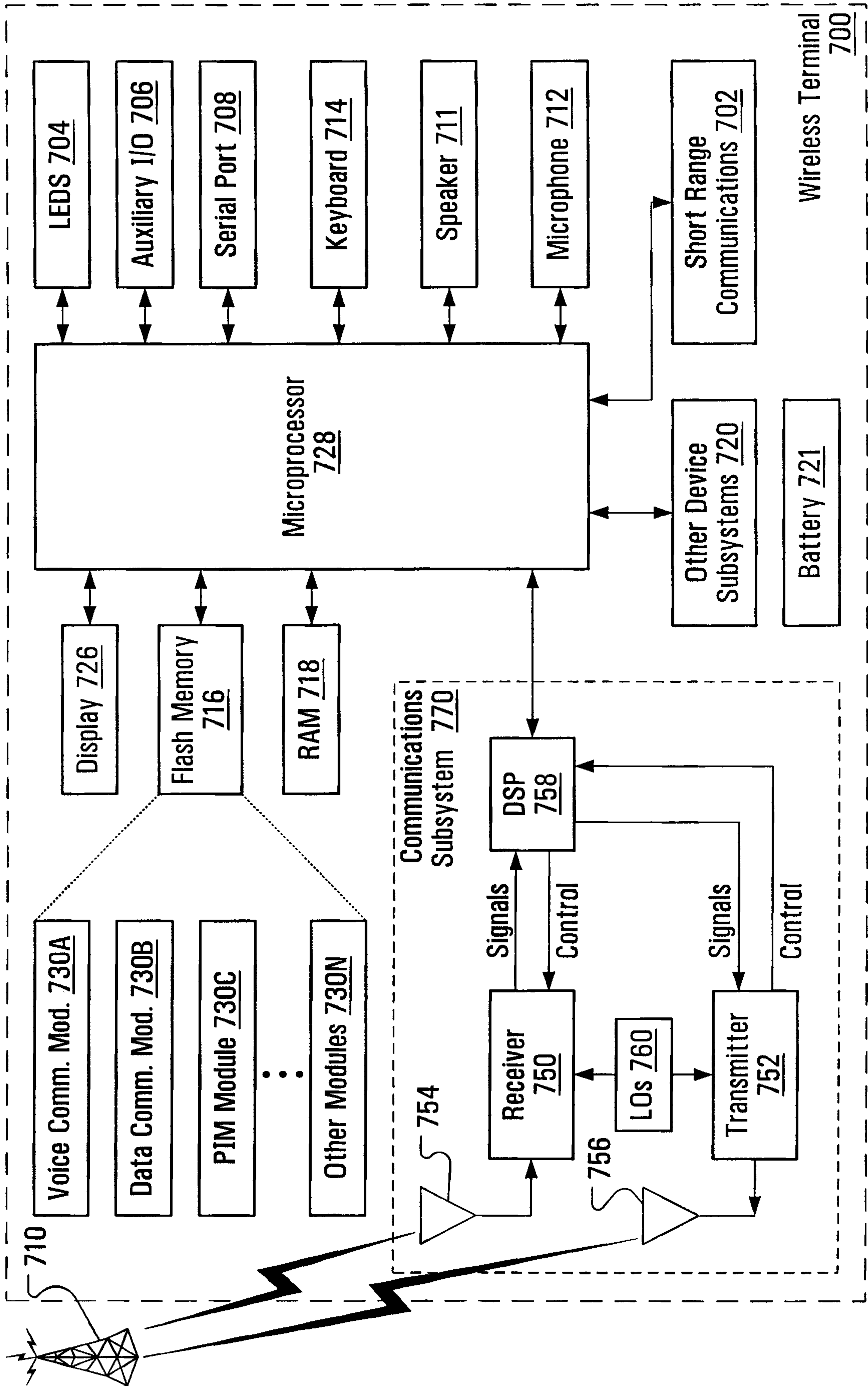
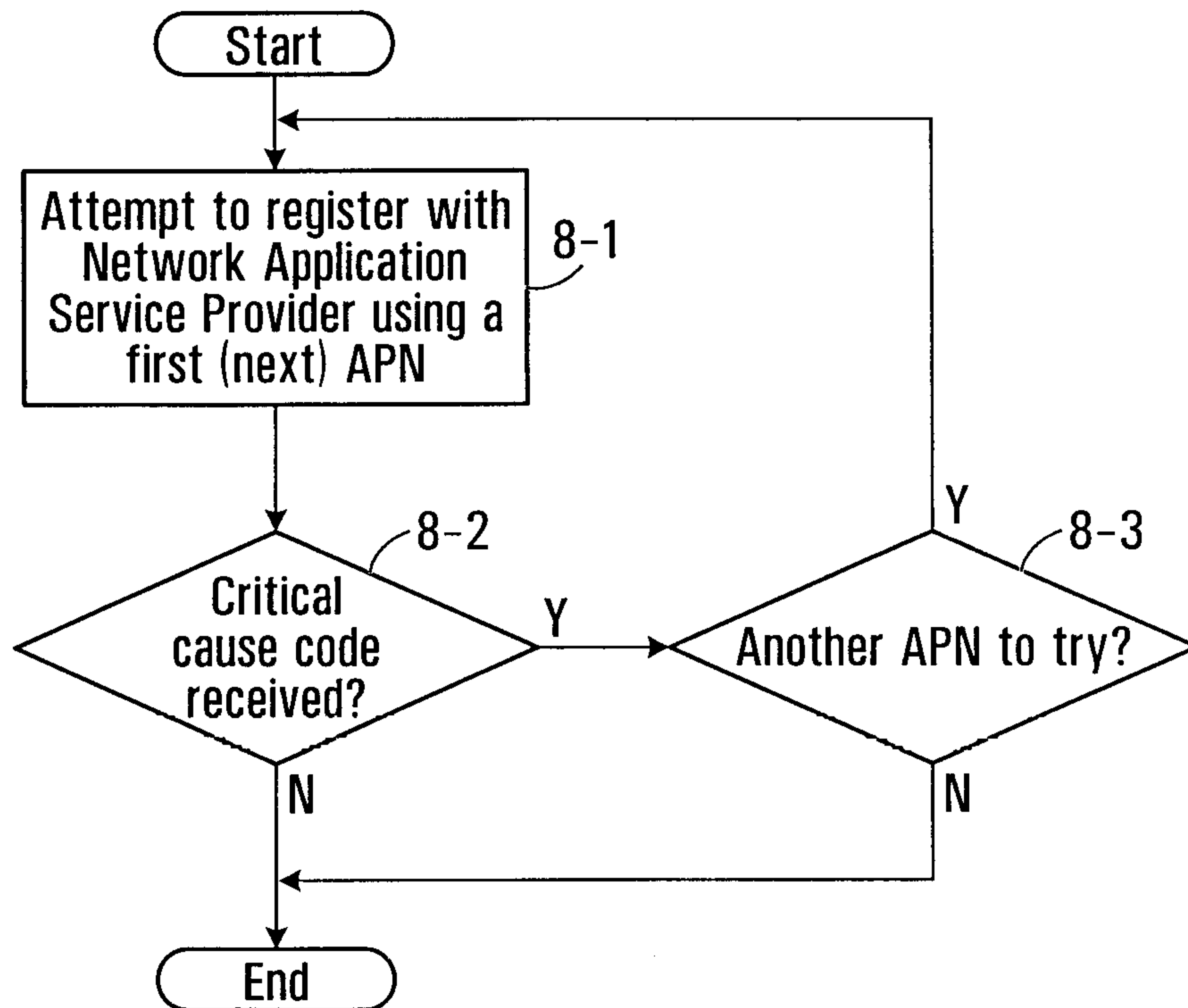


FIG. 7

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**FIG. 8**

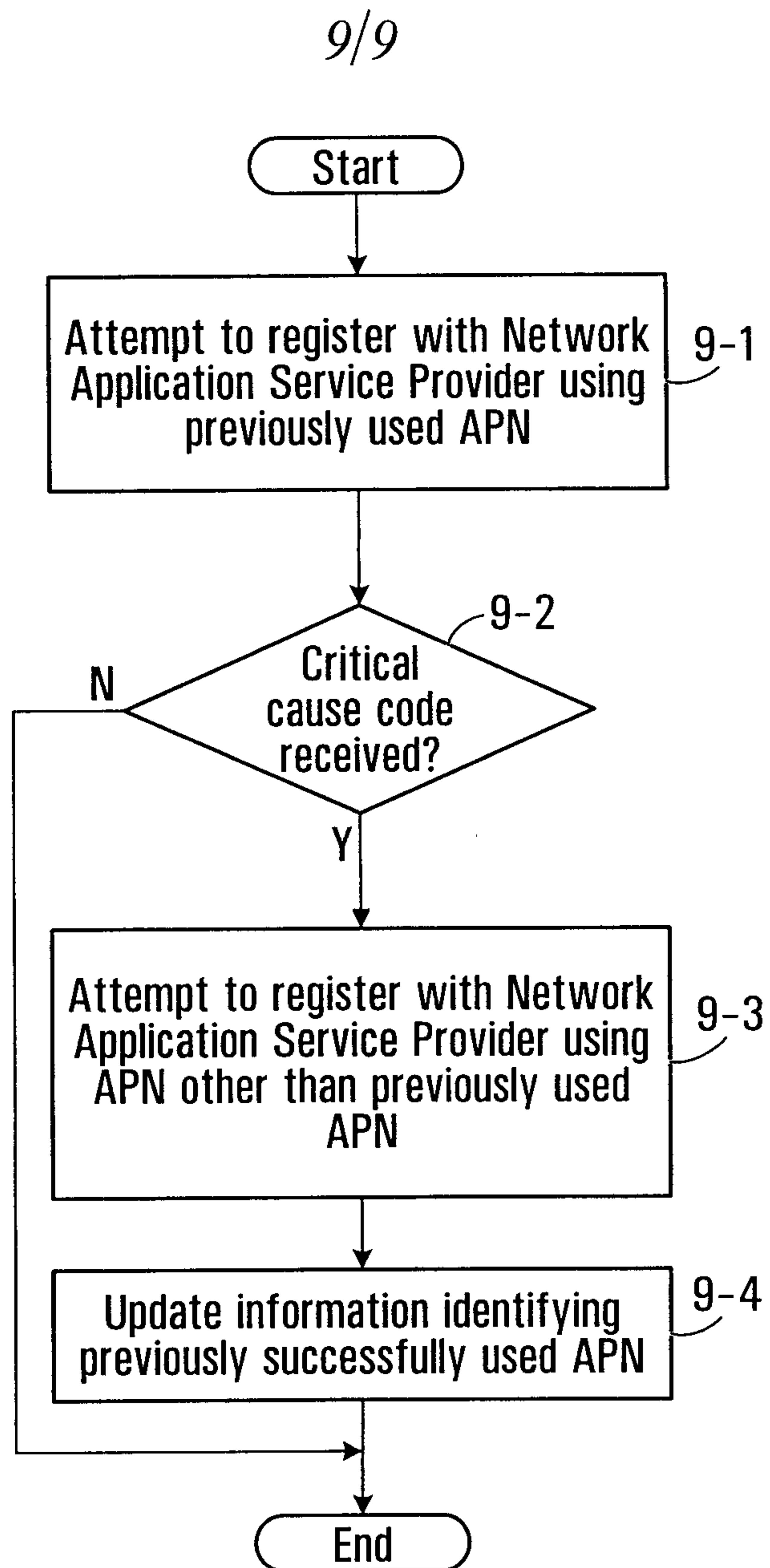


FIG. 9

