A METHOD AND SYSTEM FOR PROVISIONING WIRELESS SERVICES

FIELD OF THE APPLICATION

[0001] This application relates to the field of service provisioning for wireless devices, and more specifically, to dynamic provisioning of wireless devices for services offered by value-added service providers.

BACKGROUND

[0002] Current generations (e.g., "2.5G" and "3G") of wireless mobile communication devices include microprocessors, information storage capability, and run one or more software applications. Examples of software applications used in these wireless devices include micro-browsers, address books, and email clients. Additionally, these generations of wireless devices have access to a plurality of services via the Internet. A 3G wireless device may, for example, be used to browse Web sites on the Internet, to transmit and receive graphics, and to execute streaming audio and/or video applications. The transfer of Internet content to and from wireless device is typically facilitated by the Wireless Application Protocol (WAP), which integrates the Internet and other networks with wireless network platforms.

[0003] Before a consumer can use a wireless device, a number of parameters must be provisioned into the wireless device in order to enable communication services and applications and in order to distinguish the wireless device from others within the communications network. Provisioning may typically include programming the wireless device with a telephone number and programming the wireless network with the serial number and telephone number of the wireless device. Thus programmed, the wireless device and wireless network are enabled to carry calls between the wireless device and the public switched telephone network (PSTN). Provisioning may also include programming the wireless network and wireless device to support one or more optional

features for the wireless device, such as call forwarding, three-way calling, voice messaging, short messaging, email forwarding, and paging.

[0004] Traditionally, provisioning of a wireless device has been performed on the premises of the vendor or distributor of the wireless device. A data port on the wireless device is used to connect the device to a programming system that uploads provisioning data into the wireless device, such as the telephone number assigned to the wireless device, in order to program it for use on the wireless network. Alternatively, the wireless device is programmed through its key pad. This approach requires the often undesirable step of provisioning the wireless device before it can be delivered to a subscriber.

[0005] The ability to deliver a wireless device directly to a subscriber without first having to provision the wireless device provides improved speed of delivery to the subscriber and a simplified provisioning process. As such, wireless service providers can sell their wireless devices directly to potential subscribers through, for example, display booths in supermarkets and department stores.

[0006] To facilitate such direct sales to potential subscribers, and to make wireless services as convenient and as affordable as possible, over-the-air (OTA) service provisioning was introduced. In OTA provisioning, simple instructions are provided to guide the buyer through the process of activating the wireless device and signing up for wireless services to become a subscriber. For example, the buyer can activate a new wireless device and sign up for service by dialling a predetermined number (e.g., "*228xx") in accordance with the wireless device's instructions. Dialling the predetermined number on the wireless device keypad automatically initiates a special purpose call that connects the buyer to an operator. The operator requests certain account information from the buyer, such as personal information, a credit card number, and a home billing address. When the account information is collected and the account is set up, the operator instructs the buyer to enter a sequence of passwords, code numbers, menu-selected commands, etc., that enable certain functions in the wireless device.

[0007] To automate service provisioning even further, service provisioning solutions now allow at least part of the OTA service provisioning process to be performed by accessing a provisioning server from an unprovisioned wireless device via an Internet connection. Using an Internet connection allows a wireless service provider to consolidate service provisioning applications and data in a central repository.

[0008] In addition to provisioning the wireless device, it is also necessary to provision elements in the wireless communications network which are responsible for effecting mobile communications services and applications (e.g., billing plan, voice mail, call forwarding, email, information services, etc.). These elements include servers and other network devices maintained by wireless carriers, service providers (SPs), value-added resellers (VARs), and mobile virtual network operators (MVNOs).

[0009] A wireless carrier or wireless network operator typically owns and operates a wireless network including radio equipment, base stations, antennae, interface equipment, servers, associated landlines, etc. A carrier also manages basic billing and other back-end services needed to sell wireless services to subscribers. The carrier may sell wireless services directly to subscribers in which case the carrier is also an SP. The carrier may also partner with a VAR, a form of SP who sells the carrier's services and may also provide certain additional services. In addition, the carrier may sell otherwise unused network capacity to one or more MVNOs. A MVNO is an SP that does not maintain its own wireless network (i.e., radio equipment). MVNOs may include large retailers, cable operators, and consumer goods companies with important brands. Unlike SPs and VARs, MVNOs offer their own unique content or marketing cachet to subscribers and often serve specific target markets or interests. MVNOs enable carriers to attract new market segments and thereby load their networks more fully. Carriers can devolve marketing, sales, billing, customer relations, and related front and back office functions to MVNOs who may provide these functions more efficiently for their target markets than can the carriers themselves. Thus, SPs, VARs, and MVNOs have similar and often overlapping roles.

[0010] One shortcoming of present provisioning systems is their inability to effectively deal with service assignment conflicts between wireless devices and supporting wireless network elements such as SPs' customer service systems. A service assignment conflict exists when services assigned to a wireless device differ from services assigned to the subscriber associated with the wireless device in an SP's customer service system. The need to effectively handle service assignment conflicts is increasing in importance with the increase in the number of SPs, VARs, and MVNOs on wireless networks. Other shortcomings with present provisioning systems are their inabilities to effectively support service provisioning on disparate networks, control service access without requiring additional development or processes, restrict access to services at the individual subscriber or handheld level, control service access to a group of subscribers or handhelds without requiring different hardware, and prevent fraudulent use of unauthorized services.

[0011] A need therefore exists for an improved method and system of provisioning wireless devices and services. Accordingly, a solution that addresses, at least in part, the above and other shortcomings is desired.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] Features and advantages of the embodiments of the present application will become apparent from the following detailed description, taken in combination with the appended drawings, in which:

[0013] FIG. 1 is a block diagram illustrating an exemplary provisioning system adapted for implementing an embodiment of the application;

[0014] FIG. 2 is a block diagram illustrating a wireless network environment including the provisioning system in accordance with an embodiment of the application;

[0015] FIG. 3 is a flowchart illustrating general operations of modules within a provisioning system for managing subscriber services in accordance with an embodiment of the application;

[0016] FIG. 4 is a flowchart illustrating operations of modules within a provisioning system for subscriber service provisioning in accordance with an embodiment of the application;

[0017] FIG. 5 is a flowchart illustrating operations of modules within a provisioning system for handheld service assignment in accordance with an embodiment of the application; and,

[0018] FIG. 6 is a flowchart illustrating operations of modules within a provisioning system for reconciling subscriber services in accordance with an embodiment of the application.

[0019] It will be noted that throughout the appended drawings, like features are identified by like reference numerals.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0020] The following detailed description of the embodiments of the present application does not limit their implementation to any particular computer programming language. The embodiments may be implemented in any computer programming language provided that the operating system (OS) provides the facilities that may support the requirements of the present application. A preferred embodiment is implemented in the Java™ computer programming language (or other computer programming languages such as C or C++). (Java and all Java-based trademarks are the trademarks of Sun Microsystems Corporation.) Any limitations presented would be a result of a particular type of operating system or computer programming language and would not be a limitation of the present application.

[0021] According to one aspect of the application, there is provided a method for provisioning wireless devices for use of services offered by a service provider on a wireless network, comprising: receiving at a provisioning system from a wireless device a wireless device identifier, the wireless device having a first subset of the services; identifying from the wireless device identifier a subscriber associated with the wireless device, the subscriber having a second subset of the services; and, if the first and second subsets conflict, enabling none, one, or both of the first and second subsets of services in accordance with conflict resolution information for the service provider.

[0022] Preferably, the method further comprises, before enabling none, one, or both of the first and second subsets of services, comparing the first and second subsets for conflict.

[0023] Preferably, the method further includes transmitting to the service provider an error message if the first and second subsets conflict.

[0024] Preferably, the wireless device identifier is stored in a memory device of the wireless device.

[0025] Preferably, the memory device is a subscriber identity module (SIM).

[0026] Preferably, the services include electronic mail services.

[0027] Preferably, the provisioning system is operated by a second service provider such as a value-added service provider (VASP).

[0028] In accordance with further aspects of the present application there is provided an apparatus such as a provisioning system, a method for adapting this system, as well as articles of manufacture such as a computer readable medium having program instructions recorded thereon for practising the method of the application.

[0029] FIG. 1 is a block diagram illustrating an exemplary provisional system **100** adapted for implementing an embodiment of the application. The provisioning system

100 includes an input device **110**, a central processing unit or CPU **120**, memory **130**, a display **140**, and an interface **150**. The input device **110** may include a keyboard, mouse, trackball, remote control, or similar device. The CPU **120** may include dedicated coprocessors and memory devices. The memory **130** may include RAM, ROM, or disk devices. The display **140** may include a computer screen, terminal device, or a hardcopy producing output device such as a printer or plotter. And, the interface **150** may include a network connection including an Internet connection. The provisioning system **100** is adapted for provisioning wireless devices **210** in a wireless network environment **200**(see FIG. 2).

[0030] The provisioning system **100** may be a server system or a personal computer (PC) system. The CPU **120** of the data provisioning system **100** is operatively coupled to memory **130** which stores an operating system (not shown), such as IBM Corporation's OS/2™, UNIX, etc., for general management of the system **100**. The interface **150** may be used for communicating to external data processing systems through a network (see FIG. 2), such as the Internet. Examples of suitable platforms for the provisioning system **100** include iSeries™ servers and ThinkCentre™ personal computers available from IBM Corporation. The provisioning system **100** may include application server software (not shown), such as WebLogic® Server available from BEA Systems, Inc., for developing and managing distributed applications.

[0031] The provisioning system **100** may include a database system **160** for storing and accessing programming information. The database system **160** may include a database management system (DBMS) and a database and is stored in the memory **130** of the provisioning system **100**. It will be appreciated that the database system **160** may be shipped or installed without the database to or by end users. In general, the DBMS is adapted to read a query generated by the provisioning system **100** in response to a request for information submitted by a user typically through a user interface. The DBMS then executes the query against the database and provides a query result to the provisioning system **100** for presentation to the user. It will be appreciated that the database system

160 may be stored in the memory **130** of the provisioning system **100** or stored in a distributed provisioning system (see FIG. 2).

[0032] Examples of suitable DBMSs include the Oracle® and DB2™ Universal Database Management System products available from Oracle Corporation and IBM Corporation, respectively. The DBMS is a software layer interposed between the actual database (i.e. the data as stored for use by the CPU **120** of the system **100**) and the users of the system. The DBMS is responsible for handling database transactions thus shielding users from the details of any specific computer hardware or database implementation. Using relational techniques, the DBMS stores, manipulates and retrieves data in the form of table-like relations typically defined by a set of columns or attributes of data types and a set of rows (i.e. records or tuples) of data. The standard database query language for dealing with relational databases implemented by most commercial DBMSs is the Structured Query Language (SQL).

[0033] The provisioning system **100** includes computer executable programmed instructions for directing the system **100** to implement the embodiments of the present application. The programmed instructions may be embodied in one or more software modules **170** resident in the memory **130** of the provisioning system **100**. Alternatively, the programmed instructions may be embodied on a computer readable medium (such as a CD disk or floppy disk) which may be used for transporting the programmed instructions to the memory **130** of the provisioning system **100**. Alternatively, the programmed instructions may be embedded in a computer-readable, signal-bearing medium that is uploaded to a network by a vendor or supplier of the programmed instructions, and this signal-bearing medium may be downloaded through the interface **150** to the provisioning system **100** from the network by end users or potential buyers.

[0034] The CPU **120** of the system **100** is typically coupled to one or more devices **110** for receiving user commands or queries and for displaying the results of these commands or queries to the user on a display **140**. For example, user queries may be transformed into a combination of SQL commands for producing one or more tables of

output data which may be incorporated in one or more display pages for presentation to the user. The CPU **120** is coupled to memory **130** for containing programs **170** and data such as base tables or virtual tables such as views or derived tables. As mentioned, the memory **130** may include a variety of storage devices including internal memory and external mass storage typically arranged in a hierarchy of storage as understood to those skilled in the art.

[0035] A user may interact with the provisioning system **100** and its software modules **170** using a graphical user interface (GUI) **180**. The GUI **180** may be Web-based and may be used for monitoring, managing, and accessing the provisioning system **100**. GUIs are supported by common operating systems and provide a display format which enables a user to choose commands, execute application programs, manage computer files, and perform other functions by selecting pictorial representations known as icons, or items from a menu through use of an input or pointing device such as a mouse **110**. In general, a GUI is used to convey information to and receive commands from users and generally includes a variety of GUI objects or controls, including icons, toolbars, drop-down menus, text, dialog boxes, buttons, and the like. A user typically interacts with a GUI **180** presented on a display **140** by using an input or pointing device (e.g., a mouse) **110** to position a pointer or cursor **190** over an object **191** and by "clicking" on the object **191**.

[0036] Typically, a GUI-based system presents application, system status, and other information to the user in "windows" appearing on the display **140**. A window **192** is a more or less rectangular area within the display **140** in which a user may view an application or a document. Such a window **192** may be open, closed, displayed full screen, reduced to an icon, increased or reduced in size, or moved to different areas of the display **140**. Multiple windows may be displayed simultaneously, such as: windows included within other windows, windows overlapping other windows, or windows tiled within the display area.

[0037] FIG. 2 is a block diagram illustrating a wireless network environment **200** including the provisioning system **100** in accordance with an embodiment of the application. In FIG. 2, the provisioning system **100** is located within a distributed provisioning system **224** which includes a relay system **226**, a Web client system **228**, a customer relationship management (CRM) database system **230**, and a public mobile data service (PMDS) system **222**. Of course, the functionality of the relay system **226**, Web client system **228**, CRM database system **230**, and PMDS system **222** may be included within the provisioning system **100**.

[0038] The CRM database system **230** includes servers for storing and accessing subscriber billing, service provider, and related information. The CRM database system **230** may include CRM applications and enterprise resource planning (ERP) applications available from SAP® AG. The CRM database system **230** generates invoice messages **250** for service providers **214** (i.e., carriers, VARs, MVNOs, and other SPs). The provisioning system **100** is coupled to the CRM database system **230** and passes updated and newly created service contract messages **254** to the CRM database system **230**.

[0039] The Web client system **228** includes servers for providing an Internet-based email interface for wireless device subscribers. Through the Web client **228**, email is directed to wireless devices or handhelds **210** over the wireless network **212**. The Web client **228** allows subscribers to add email account services for operation through their wireless devices **210**. Email is redirected wirelessly to subscribers' wireless devices **210** so that subscribers can send, receive, forward, and reply to messages wirelessly. In addition, the Web client system **228** allows subscribers to access their email account over the Internet with a landline-based PC. Each SP **214** may have its own Web client system **228** site (i.e., a "Web client site") for its subscribers. Services provided by the Web client site are configurable based on the SP **214**. Advantageously, not only can carriers access a Web client **228** site to manage subscriber setting **246**, but so can VARs, MVNOs, and other SPs. The Web client system **228** is coupled to the provisioning system **100** for exchanging enable/block service access messages **252**, **253**.

[0040] The relay system **226** includes servers for transferring information between the provisioning system **100** and wireless devices **210** over the wireless network **212**. As discussed above, the wireless network **212** is generally owned and operated by a carrier **214**. It is through the relay system **226** that the provisioning system **100** is coupled to the wireless network **212**. The relay system **226** handles a variety of low level operations for subscribers **210**. The relay system **226** receives registration messages **258** from wireless devices **210** and passes these messages to the provisioning system **100**. In return, the provisioning system **100** passes enable/block service access messages **256** to the relay system **226**.

[0041] Each SP **214** has a carrier customer service system **216** which is coupled to a carrier provisioning system **218**. The carrier customer service system **216** may be similar in component configuration to the provisioning system **100** (see FIG. 1). The carrier customer service system **216** provides the carrier provisioning system **218** with activate subscriber messages **260**. In turn, the carrier provisioning system **218** provides activate network service messages **240** to the wireless network **212** for transmission to the distributed provisioning system **224** and/or wireless devices **210**. In addition, and as mentioned above, the carrier customer service system **216** of the SP **214** receives invoice messages **250** from the CRM database system **230**. Furthermore, the carrier customer service system **216** provides manage-service configuration **261**, subscriber service provisioning **262**, and handset service assignment **263** messages to the provisioning system **100**. Moreover, the carrier provisioning system **218** provides subscriber service assignment **244** and handset service assignment **242** messages to the provisioning system **100**. Lastly, the carrier customer service system **216** provides update Web client site subscriber settings messages **246** to the Web client system **228**. Note that additional options beyond activation and service assignment are available to carriers including, for example, suspend, resume, deactivate, modify services, modify subscriber data, etc.

[0042] The PMDS system **222** includes servers for providing data services for wireless device subscribers. Through the PMDS system **228**, data is directed to wireless

devices **210** over the wireless network **212**. The provisioning system **100** provides the PMDS system **222** with enable/block service access messages **255**.

[0043] In operation, using their customer service systems **216**, SP users can log in via a Web-based user interface to the distributed provisioning system **224** to manage provisioning aspects of their respective subscribers. Thus, the distributed provisioning system **224** acts as an intermediary between SPs **214** and wireless device **210** subscribers, providing email forwarding, related billing, provisioning, and other services. In effect, the distributed provisioning system **100** is a form of SP providing specialized support and services for wireless devices such wireless handhelds. An SP may provide provisioning and related services through a branded service. Such SPs are sometimes referred to as value-added service providers (VASPs). Of course, the service may be re-branded and offered by other SPs to their subscribers.

[0044] In addition, enterprises **220** may have their own enterprise server system **221** for providing wireless device **210** based email services to their employee subscribers. The enterprise server system **221** is managed by the enterprise **220**. It is coupled to the relay system **226** and though the relay system **226** to the wireless network **212**. The enterprise server system **221** receives synchronization messages **257** from the relay system **226**.

[0045] Enterprises **220** may also have a dedicated "prosumer" server system (not shown) integrated with the distributed provisioning system **224** for providing wireless device **210** based email services to their employee subscribers. A prosumer (also referred to as professional consumer) server system is system having specifications which fall between those of professional systems at a higher end and consumer system at a lower end. In this case, the prosumer server system is managed by the VASP. It is coupled to the relay system **226** and though the relay system **226** to the wireless network **212**. The prosumer server system receives synchronization messages (not shown) from the relay system **226**.

[0046] One aspect of the present application extends the ability of SPs **214** to control access and services and to dynamically resolve service assignment conflicts. In general, the provisioning system **100, 224** of the present application provides a method of controlling access to various services offered by VASPs. The provisioning system **100, 224** is used by SPs **214** to activate/manage/deactivate subscriber services. Service subscribers use the provisioning system **100, 224** for activating and managing services that they have subscribed to. The provisioning system **100, 224** provides the VASP with administrative capabilities for managing these service subscribers. The provisioning system **100, 224** also provides subscriber activation records to the CRM database system **230** for billing purposes, etc. Furthermore, the provisioning system **100, 224** provides external interfaces such as HTML, XML, and WML for SPs **214** and subscribers to use. Thus, the present application provides SPs **214** with an increased level of control and management of wireless device **210** subscribers.

[0047] The expressions defined below will be used in the description to follow:

1. "Default XML/Web Subscriber Services": If no service is specified through the Web or XML interface **216** when a transaction is submitted, a default service is implicit in every request. This setting is managed as an element of the SP's service configuration **261**.

2. "Default Registration Subscriber Services": If no services are enabled for a particular subscriber when registration **258** occurs, the default registration service (or services) are assigned. This setting is managed as an element of the SP's service configuration **261**.

3. "Default Handset Services": If no services are assigned for a particular handheld **210** when registration **258** occurs, the default handset service (or services) are assigned. This setting is managed as an element of the SP's service configuration **261**. Default handset services may be based on device type, manufacturer, software revision, etc.

4. "Service Reconciliation" occurs when services have been activated for a subscriber and assigned to a handheld **210** prior to the subscriber/handset registering **258**. Service reconciliation may reveal a service conflict or may require additional actions to ensure service access is updated appropriately.

5. "Service Conflict": Service conflicts occur when conflicting service settings are detected for a subscriber and a handset **210**. Service conflicts are resolved by applying the SP's service conflict resolution policy information.

6. "Service Conflict Resolution Policy": SPs have the ability to decide whether a service conflict results in the handheld **210** or subscriber service assignment taking priority. This setting is managed as an element of the SP's service configuration **261**.

7. "Handheld Service Type Assignment": SPs can determine the default service type for their handhelds **210**. By assigning a service type to a handheld **210**, the SP is able to determine the provisioning experience the user will have on their handheld **210** when first turned on. SPs have the ability to change the service type assignment for any handheld **210** at any time.

8. "Service Access Control": Service access control provides SPs with the ability to manage and control the services their subscribers have access to. By using service access control, subscribers can be limited to a particular service, regardless of the wireless handheld **210** they are using.

9. "Enterprise service": Enterprise service subscribers (i.e., enterprises **220** having an enterprise server system **221** and their subscribers) have their wireless email service enabled through their enterprise's

information technology (IT) department. In other words, enterprise service does not use a handheld-based provisioning model. Handhelds **210** that are assigned to the enterprise service type are not provided with any handheld-based provisioning methods upon activation;

10. "Prosumer service": Prosumer service subscribers (i.e., enterprises **220** having a prosumer server system and their subscribers) have their wireless email service enabled through a handheld-based provisioning model, providing an easy to use method for subscribers to set-up their email service. Handhelds **210** that are assigned to the prosumer service type are provided with the handheld-based provisioning methods as configured by the SP at the time of handheld activation.

[0048] FIG. 3 is a flowchart illustrating general operations **300** of modules **170** within a provisioning system **100**, **224** for managing subscriber services in accordance with an embodiment of the application. Handheld service type assignment and service access control are both managed through the provisioning system **100**, **224**. SPs **214** can use either the HTML or XML interface to manage their subscribers and their handhelds **210**.

[0049] SPs **214** manage their profile and default settings through their customer service systems **216** which include Web interfaces to the provisioning system **100**, **224**. Interfaces are provided to allow for the management of service setting profiles and for the configuration of service conflict override rules. Override rules are used to automatically resolve service conflicts between subscribers and handhelds **210** when a manual override is not specified. Override rules can be specified at the subscriber or handheld level or at the individual service level.

[0050] At step **310**, the operations **300** start. Users such as SP managers and administrators have access to their profiles through the provisioning system's Web interface **216**.

[0051] At steps **320**, **330**, **340**, **350**, **360**, **370**, users can manage default registration service profiles, manage default Web/XML service profiles, manage service management settings, manage registration policies, manage service book settings, and set service conflict resolution policies, respectively.

[0052] At step **380**, the operations **300** end with the completion of service management processing.

[0053] Other aspects of the present application provide several improvements in wireless device service provisioning as follows. The present application provides a generic provisioning system **100**, **224** that supports service provisioning and access control on disparate networks including CDMA (Code-Division Multiple Access), GPRS (General Packet Radio Service), Mobitex, and Motorola's iDEN (Integrated Digital Enhanced Network) and DataTAC™ networks. The present application provides SPs **214** with means to control service access without requiring additional development or processes. The present application provides SPs **214** with means to restrict access to services at the individual subscriber or handheld level. The present application provides SPs **214** with means to control service access to a group of subscribers or handhelds without requiring different hardware. This addresses the "two SKU problem", that is, the problems created when an SP must maintain more that one stockkeeping unit (SKU) for a handheld **210**. Finally, the present application helps prevent fraudulent use of unauthorized services without introducing any additional development or processes on the part of SPs.

[0054] In more detail, the provisioning system **100**, **224** provides generic interfaces **216** to SPs **214** that are independent of any specific network technology. These interfaces include a standards-based business-to-business (B2B) interface (e.g., WebService with SOAP, XML, etc.) as well as a Web interface to manage their subscribers, handhelds, and account profiles. Each SP **214** is able to define unique identifiers for their subscribers and handhelds **210** based on the parameters inherent in their technology. For example, if an SP is GPRS-based, then it may use network-specific identifiers such as IMSI

(International Mobile Subscriber Identity), ICCID (Integrated Circuit Card Identifier), MSISDN (Mobile Station Integrated Services Digital Network), and/or IMEI (International Mobile Equipment Identity). These network-specific identifiers are then mapped to a service-specific identifier (i.e., a PIN or personal identification number) for universal access control at a centralized point (i.e., the relay system **226**) in the provisioning system **100**, **224**. Management of the generic interfaces, the carrier profile configuration, and the mapping between network-specific identifiers and a generic service-specific identifier is handled by the provisioning system **100**, **224**.

[0055] The relay system **226** uses named parameters to pass a registration message **258** to the provisioning system **100**, **224** through the provisioning system's registration interface (not shown). This information may be passed by an HTTP post. For Mobitex and DataTAC registrations, the relay system **226** may pass the following parameters (strings) to the provisioning system **100**, **224**: Relay ID (a string in decimal format); PIN; ESN (Electronic Serial Number); and, Invalid PIN (a string which can be "0" or "1", with "1" indicating that the PIN is blocked in the relay system **226**). For a GPRS registration, as mentioned above, the relay system **226** may pass the following parameters (strings) to the provisioning system **100**, **224**: Relay ID; PIN; IMEI; IMSI; ICCID; MSISDN MDN (a string representing the phone number); and, Invalid PIN. For a CDMA registration, the relay system **226** may pass the following parameters (strings) to the provisioning system **100**, **224**: Relay ID; PIN; ESN; IMSI; MSISDN MDN; and, Invalid PIN. And, for an iDEN registration, the relay system **226** may pass the following parameters (strings) to the provisioning system **100**, **224**: Relay ID (a string in decimal format); PIN; IMEI; MSISDN MDN (a string representing the phone number); SIM ID (Subscriber Identity Module ID); and, Invalid PIN.

[0056] The relay system **226** is able to determine the network type for each registration packet. It provides an interface to the provisioning system **100**, **224** to block registration flow on a per network or carrier basis. The registration interface of the

provisioning system **100**, **224** is able to determine the SP for every valid registration and is able to discard a registration on a per SP basis.

[0057] Now, many SPs **214** are not able to take on additional development to launch a particular service. At the same time these SPs **214** demand that service access be controlled by a centralized system. The provisioning system **100**, **224** supports the creation of "carrier service profiles" so that SPs can define the services they want their subscribers and handhelds to be granted by default when the subscriber/handheld **210** registers with the provisioning system **100**, **224**. SPs can set-up exactly what services they would like each class of handheld to be granted or whether a class of handhelds is not to be granted any access. This is enforced by the provisioning system **100**, **224** as soon as registration takes place. The class of handheld may be based on device type, manufacturer, software revision, etc.

[0058] In addition, the provisioning system **100**, **224** provides several real-time interfaces for SPs to manage service access control for their subscribers or handhelds. SPs **214** have the ability to identify individual subscribers and to activate specific services for these subscribers as part of their own provisioning process. Access control and billing of services are tied together to ensure accurate accounting for all services. A database table **160** maintains mappings of service "CLASSMASKs" that are used to identify certain classes of service in an efficient manner as each packet of data flows through the provisioning system **100**, **224**. A bit-wise comparison can be performed to quickly determine if access to a specific service has been granted.

[0059] Furthermore, SPs **214** may find it inconvenient to maintain a separate inventory of hardware for different service offering (e.g., Web client service, enterprise service, prosumer service, etc.). Previously, separate "branded" wireless devices were distributed to subscribers for these services, requiring two different SKUs. To move inventory from one SKU to another often required returning stock. This was a tedious process. However, the provisioning system **100**, **224** of the present application provides a service assignment interface to allow SPs **214** to upload batch files to enable a subset of

handhelds **210** for a specific service. The services assigned to a handheld **210** can be changed by simply updating the service assignment in a subsequent upload. The provisioning system **100, 224** maintains a database **160** of default service assignments for all handhelds and applies the appropriate service CLASSMASK to data flowing through the provisioning system **100, 224** and relating to the handheld as soon as a recognized handheld registers. Furthermore, the provisioning system **100, 224** provides SPs **214** with the ability to choose between handheld service assignment and subscriber service activation in the case where a conflict occurs between settings.

[0060] Moreover, SPs **214** typically subsidize handheld sales depending on the services being enabled for the various handhelds **210**. For example, a handheld sold with enterprise service may be priced at $400 whereas a handheld sold with prosumer service may be priced at $200. The SP **214** needs some way to ensure that the lower priced prosumer service handheld is not able to use the higher priced enterprise service. The provisioning system **100, 224** provides a means to identify the handheld type (based on pre-activation or service assignment) and ensure that only certain services are accessible by that handheld by setting and communicating a CLASSMASK to elements of the provisioning system **100, 224**. Once the CLASSMASK has been set, fraudulent use of unauthorized services becomes impossible. The provisioning system **100, 224** provides interfaces **216** for allowing an SP **214** to change the service profile for a particular subscriber or handheld **210** to allow access to a desired service (perhaps after a premium is paid).

[0061] FIG. 4 is a flowchart illustrating operations **400** of modules **170** within a provisioning system **100, 224** for subscriber service provisioning in accordance with an embodiment of the application. Subscriber service provisioning encapsulates the process of activating and managing subscriber access to services. It controls which services are available to subscribers.

[0062] At step **401**, the operations **400** start. A service provisioning request **262, 244** is submitted to the provisioning system **100, 224** by a service provider **214**. Note that

service activation requests originate from a service requestor and may be delivered through either an XML or HTML interface **216**.

[0063] At step **402**, a determination is made as to whether a service is specified. It is not required that services be specified. This step is to ensure that the interfaces are compatible with earlier versions of service provisioning software.

[0064] At step **403**, if a service is not specified, then a default service is determined. Default services are determined based on the SP's profile **261**.

[0065] At step **404**, if a service is specified then the service request is validated.

[0066] At step **405**, a determination is made as to whether the service and action are allowed.

[0067] At step **406**, if the service and action are not allowed, then an error response is formatted. A service request may fail validation if a dependency is not met or if a conflict is detected between exclusive services. Operations then proceed to final step **414** discussed below.

[0068] At step **407**, if the service and action are allowed, then a determination is made as to whether service reconciliation is required. Service reconciliation may be required if the subscriber is associated with a handheld **210** that has triggered default services on registration.

[0069] At step **408**, if service reconciliation is required, then service reconciliation is performed. Service reconciliation may require deactivation or modification of existing services. Operations then proceed to step **409**.

[0070] At step **409**, continuing from step **407**, if service reconciliation is not required, then a determination is made as to whether services require access control.

[0071] At step **410**, if services do require access control, the service access control information is updated. How access control is enforced depends on the service. For example, the relay system **226** is the primary point of control for Web client, enterprise, and browsing related services. Operations then proceed to step **411**.

[0072] At step **411**, if services do not require access control, then the service status is updated.

[0073] At step **412**, service invoicing information is updated.

[0074] At step **413**, a success response is formatted.

[0075] At step **414**, operations **400** end with the return of either a success response or an error response.

[0076] FIG. 5 is a flowchart illustrating operations **500** of modules **170** within a provisioning system **100**, **224** for handheld service assignment in accordance with an embodiment of the application.

[0077] At step **501**, the operations **500** start. A default service assignment request **263**, **242** is submitted to the provisioning system **100**, **224** by an SP **214**. Default service assignment requests originate from an SP and may be delivered through either an XML or HTML interface as single requests or in batch format.

[0078] At step **502**, the service profile for the handheld **210** is updated. The handheld service profile is used by default if specific services are not provisioned for a subscriber at registration.

[0079] At step **503**, a determination is made as to whether the handheld **210** has been registered. If the handheld **210** has been registered, it must be determined if any action is required.

[0080] At step **507**, if the handheld **210** has not been registered, then a success response if formatted. Operations then proceed to step **508**.

[0081] At step **504**, if the handheld **210** has been registered, then a determination is made as to whether the handheld **210** is associated with an active subscriber. If the handheld **210** is not associated with an active subscriber, then operations proceed to step **507**.

[0082] At step **505**, if the handheld **210** is associated with an active subscriber, then a determination is made as to whether the active service conflicts with the service allocation. If the active service does not conflict with the service allocation, then operations proceed to step **507**.

[0083] At step **506**, if the active service does conflict with the service allocation, then a warning response is formatted. Thus, even if the handheld **210** has registered and is associated with a conflicting service, the service profile is updated for future registrations. A warning is returned in this case. Operations then proceed to step **508**.

[0084] At step **508**, operations **500** end with the return of either a success response or a warning response.

[0085] FIG. 6 is a flowchart illustrating operations **600** of modules **170** within a provisioning system **100**, **224** for reconciling subscriber services in accordance with an embodiment of the application. During registration, subscriber information (see FIG. 4), provided by the SP **214** via the XML or Web provisioning interface **216**, is reconciled against handheld information (see FIG. 5) by the provisioning system **100**, **224**. A handheld **210** may be assigned services or associated with an account maintained on the Web client system **228**. Also, for certain SPs **214**, registration may trigger the activation or deactivation of services depending on the SP's registration policy and default service profile. If a service conflict exists between the handheld and the subscriber, the SP's override rules dictate behaviour.

[0086] At step **601**, the operations **600** start. A registration event or message **258** is received by the provisioning system **100**, **224**. The registration event is received when a handheld first registers with the provisioning system **100**, **224** and at various points in the handheld and subscriber lifecycle.

[0087] At step **602**, the service requestor (i.e., SP) is identified and the corresponding profile is retrieved.

[0088] At step **603**, the status of the subscriber is determined. Note that provisioning requests received through the XML or HTML interface take precedence over any service defaults.

[0089] At step **604**, a determination is made as to whether the event is a new activation.

[0090] At step **605**, if the event is not a new activation, then the default service assignment for the handheld **210** is checked. Operations then proceed to step **606**.

[0091] At step **606**, a determination is made as to whether the default service assignment is available.

[0092] At step **607**, if the default service assignment is not available, then the default service profile for the service requestor is checked. Operations then proceed to step **608**.

[0093] At step **608**, if the default service assignment is available, then a determination is made as to whether all default services are active for the subscriber. If all default services are not active for the subscriber, then operations proceed to step **616** described below.

[0094] At step **609**, if all default services are active for the subscriber, then no action is required and operations **600** end.

[0095] At step **610**, continuing from step **604**, if the event is a new registration, the service requestor registration policy is checked.

[0096] At step **611**, if the service requestor registration policy is "notify", then the service requestor is notified (e.g., by email). Notification may delay the processing of the registration event typically for 24 hours after which the subscriber will either be activated or deactivated depending on the service requestor's policy settings. Operations **600** then end.

[0097] At step **620**, if the service requestor registration policy is "deactivate", then the service is deactivated. Operations then proceed to step **621**.

[0098] At step **612**, if the service requestor registration policy is "activate", then a determination is made as to whether the handheld is branded. If the handheld is not branded, then operations proceed to step **614** where the default service assignment for the handheld is checked. If the handheld is branded, then operations proceed to step **613** where the default service profile for branding is checked. At step **615**, continuing from step **613**, a determination is made as to whether the default branding service is found. If the default branding service is found, then operations proceed to step **616**. If the default branding service is not found, then operations proceed to step **614**.

[0099] At step **618**, continuing from step **614**, a determination is made as to whether the default service assignment is available. If the default service assignment is available, then operations proceed to step **616**.

[0100] At step **619**, if the default service assignment is not available, then the default service profile for the service requestor is checked. Operations then proceed to step **616**.

[0101] At step **616**, continuing from steps **608**, **618**, **619**, or **615**, a determination is made as to whether service reconciliation is required. If service reconciliation is not required, operations then proceed to step **621**.

[0102] At step **617**, if service reconciliation is required, then service reconciliation is performed.

[0103] At step **621**, continuing from steps **620**, **617**, or **616**, access control information is updated.

[0104] At step **622**, service status information is updated.

[0105] At step **623**, operations **600** end with updating of service invoicing information.

[0106] As mentioned above, available services include the enterprise and prosumer services. OTA activation is an option for enterprise subscribers as well as prosumer subscribers. However, different provisioning mechanisms may be provided for both types of subscribers which can be controlled by the services provisioned for an individual subscriber or handset.

[0107] Service assignment and service access control can be set for either of these services or both, meaning a handheld **210** or subscriber can be assigned access to enterprise-only, prosumer-only, or both. As such, service types include the following: enterprise-only; prosumer-only; and, enterprise and prosumer.

[0108] SPs **214** have the ability to assign a service type to their handhelds **210**. This assignment will determine which handheld-based provisioning model will be exposed to the subscriber. It is important to note that service type assignment is "overridden" by the service access control set for a subscriber when present. This means that a handheld that was assigned to the enterprise service type would receive the prosumer service type experience if the subscriber were given access to the prosumer service.

[0109] The present application provides for pre-assignment of services as follows. SPs **214** select a default service type for the handhelds **210** that they sell. When a handheld **210** is first activated in the provisioning system **100**, **224**, the handheld **210** will

be subject to the provisioning model defined by the SP **214** for that service type, unless the subscriber service access control specifies otherwise. If the SP wishes to pre-assign a different service type for a subset of handhelds, it is able to do this by providing a list of handheld identifiers (e.g., PIN, ESN/IMEI, etc.) and the service type assignment for that subset.

[0110] The present application also provides for real-time assignment of services as follows. SPs **214** are able to submit to the provisioning system **100, 224** in real-time, a modification of the handheld's default service assignment. This is typically done during the subscriber provisioning process, although it can also be done at any other time. SPs may choose to not update the service type assignment and simply use the service access control setting to dictate which provisioning experience the subscriber will have with their handheld **210**, since it overrides the service type assignment when a conflict occurs.

[0111] With respect to subscriber service access control, SPs **214** are able to submit to the provisioning system **100, 224** during the subscriber provisioning process which service type a subscriber has access to. Once assigned, the subscriber will not have access to any other service type. The subscriber service type assignment can be changed at any time using the provisioning system **100, 224** (via HTML or XML).

[0112] SPs **214** can use the provisioning system **100, 224** to manage handheld service type assignment and service access control. Using either an HTML or XML interface, SPs are able to define service types for both handhelds and subscribers. In addition, the HTML interface supports the uploading of batch files for groups of handhelds or subscribers.

[0113] Now, for example, consider the case where a subscriber purchases a "prosumer-only" handheld **210** but subscribes to "enterprise-only" service. In operation, the following steps are performed:

[0114] 1) The subscriber has a handheld **210** that is assigned to the prosumer service type only.

[0115] 2) Upon activation by the SP **214**, an activation request (via HTML or XML) specifies that this subscriber should have access to enterprise-only service.

[0116] 3) If a "conflict override setting" has been enabled by the SP **214**, or if the activation request specifies that if there is a conflict it should be overridden, then the provisioning system **100**, **224** will automatically change the handheld service type assignment to enterprise-only.

[0117] 4) If the "conflict override setting" has not been enabled as the SP default, then an error message will be returned to the SP.

[0118] Next, consider the case where a subscriber purchases a "prosumer-only" handheld and "prosumer-only" service but wishes to change to "enterprise-only" service. In operation, the following steps are performed:

[0119] 1) The subscriber has a handheld **210** that is assigned to the prosumer service type only.

[0120] 2) The subscriber is currently assigned to the prosumer service type only.

[0121] 3) The SP **214** submits a deactivation request for prosumer-only service and submits activation request for enterprise-only service.

[0122] 4) If the "conflict override setting" has been enabled as the SP default, or if the activation request specifies that if there is a conflict it should be overridden, then the provisioning system **100**, **224** will automatically change the handheld service type assignment to enterprise-only.

[0123] 5) If the "conflict override setting" has not been enabled as the SP default, then an error message will be returned to the SP.

[0124] Finally, consider the case where a subscriber purchases a "enterprise-only" service and places a "prosumer-only" SIM in his/her handheld **210**. In operation, the following steps are performed:

[0125] 1) The subscriber has a new handheld **210** that is assigned to the prosumer-only service type.

[0126] 2) The subscriber is currently assigned to the enterprise-only service type.

[0127] 3) The provisioning system does not allow this subscriber to have access to his/her enterprise service on this handheld **210** due to a service access control conflict. The outcome here depends on the carrier's service conflict policy. Either subscriber service or handheld service could prevail.

[0128] 4) At the point of sale, the subscriber would need to specify that he/she wants to use this handheld **210** with enterprise-only service or the subscriber would need to contact the SP **214** and request to be enabled for enterprise-only service on that handheld **210**.

[0129] 5) The SP **214** submits a request to change handheld service assignment from prosumer-only to enterprise-only.

[0130] While this application is primarily discussed as a method, a person of ordinary skill in the art understands that the apparatus discussed above with reference to a provisioning system may be programmed to enable the practice of the method of the application. Moreover, an article of manufacture for use with a provisioning system, such as a pre-recorded storage device or other similar computer readable medium including program instructions recorded thereon may direct the provisioning system to facilitate the practice of the method of the application. It is understood that such apparatus and articles of manufacture also come within the scope of the application.

[0131] The embodiments of the application described above are intended to be examples only. Those of skill in the art may effect alterations, modifications and variations to the particular embodiments without departing from the scope of the application. The subject matter described herein in the recited claims intends to cover and embrace all suitable changes in technology.

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CLAIMS

1. A method for provisioning wireless devices (**210**) for use of services offered by a service provider (**214**) on a wireless network (**212**), comprising:

receiving at a provisioning system (**100, 224**) from a wireless device (**210**) a wireless device identifier, the wireless device (**210**) having assigned a first subset of the services;

identifying from the wireless device identifier a subscriber associated with the wireless device (**210**), the subscriber having activated a second subset of the services;

comparing the first and second subsets for conflict; and

if the first and second subsets conflict, enabling none, one, or both of the first and second subsets of services in accordance with conflict resolution information for the service provider (**214**).

2. The method of claim 1, further comprising transmitting to the service provider (**214**) an error message if the first and second subsets conflict.

3. The method of claims 1 or 2, wherein the wireless device identifier is stored in a memory device of the wireless device (**210**).

4. The method of claim 3, wherein the memory device is a subscriber identity module (SIM).

5. The method of any one of claims 1 to 4, wherein the services comprise electronic mail services.

6. The method of any one of claims 1 to 5, wherein the provisioning system (**100, 224**) is operated by a second service provider.

7. A system for provisioning wireless devices (**210**) for use of services offered by a service provider (**214**) on a wireless network (**212**), comprising:

a processor (**120**) coupled to memory (**130**) and an interface (**150**) to the wireless network (**212**) and adapted for:

receiving at a provisioning system (**100**, **224**) from a wireless device (**210**) a wireless device identifier, the wireless device (**210**) having assigned a first subset of the services;

identifying from the wireless device identifier a subscriber associated with the wireless device (**210**), the subscriber having activated a second subset of the services;

comparing the first and second subsets for conflict; and

if the first and second subsets conflict, enabling none, one, or both of the first and second subsets of services in accordance with conflict resolution information for the service provider (**214**).

8. The system of claim 7, wherein the processor (**120**) is further adapted for transmitting to the service provider (**214**) an error message if the first and second subsets conflict.

9. The system of claim 7 or 8, wherein the wireless device identifier is stored in a memory device of the wireless device (**210**).

10. The system of claim 9, wherein the memory device (**210**) is a subscriber identity module (SIM).

11. The system of any one of claims 7 to 10, wherein the services comprise electronic mail services.

12. The system of any one of claims 7 to 11, wherein the system is operated by a second service provider.

13. A computer program product comprising a computer readable medium tangibly embodying computer code executable by the system of any of the claims 7 to 12 to implement the method of any of the claims 1 to 6 .