Title: GENERIC FEATURE LICENSING FRAMEWORK

Abstract: A system enables customers to provision devices with feature licenses that enable specified features in the devices. The system includes a feature definition module configured to store product feature information associated with different products available from a plurality of different manufacturers. The system also includes a feature license management module configured to generate, update and revoke feature licenses. The feature licenses that are generated all have a common format. The system further includes a feature credit management module configured to monitor and account for feature credits available to customer organization units. A user management module is also provided in the system, which is configured to authenticate users of the system. A user interface is accessible over a communications network through which authenticated users can request and receive feature licenses.

FIG. 1
GENERIC FEATURE LICENSING FRAMEWORK

Statement of Related Applications

[0001] This application claims the benefit of U.S. Provisional Patent Application Serial No. 61/302,072, filed February 5, 2010, which is incorporated herein by reference in its entirety.

Background

[0002] As technologies advance rapidly, manufacturers are adding an increasingly large number of features to their products. Since customer needs vary over a wide range and constantly evolve, it is necessary for manufacturers to implement systems that can handle the customization of features for the initial configuration of and the subsequent changes in the product feature set. For example, a manufacturer of mobile phones such as Motorola, for instance, may offer mobile phones that are capable of supporting a number of features in addition to voice such as data, texting, GPS services, Wi-Fi connectivity, web browsing, text-to-speech and so on. The direct customers of the manufacturer, who in the case of mobile phones are often service providers such as Verizon and ATT, for instance, may wish to obtain mobile phones with different combinations of these features in order to meet the varying needs of the end users.

[0003] To address this issue, manufacturers have turned to feature licensing, which provides a feature control mechanism that allows customers to obtain a license to enable only the product features that meet their specific needs. Feature licensing brings many benefits to both manufacturers and customers. For example, feature licensing allows manufacturers to have a single build of a product that incorporates all available features and rely on feature licensing to enable different combinations of features. In addition, customers can get the exact features for a product that meets their specific needs without having to pay for undesired features. Feature licensing also allows manufacturers and
customers to manage product upgrades and downgrades through license changes, eliminating the need to deploy different product versions and reducing operational downtime.

[0004] To achieve such benefits, however, different manufacturers, and even different organizations within the same manufacturer, have tended to build their own feature licensing systems to support their own product lines. These systems are often designed with only one or a few similar product lines in mind, and consequently cannot be easily extended to support other product lines. Once such custom-designed systems are developed, they need to be individually maintained and supported. Such repeated efforts result in increased cost in product development, deployment and support.

[0005] On the customer side, end users may have to use multiple feature licensing systems if they have products from multiple manufacturers. Different user interfaces and processes in different feature licensing systems for similar tasks can cause confusion in users, which leads to the need for increased user training and support efforts.

**Brief Description of the Drawings**

[0006] FIG. 1 shows the logical architecture of one implementation of a feature licensing system.

[0007] FIG. 2 illustrates the logical relationship among products, product lines, features and feature rules.

[0008] FIG. 3 shows an example of a user interface provided by the feature license management module.

[0009] FIG. 4 shows an illustrative user interface through which the user can download in a batch mode the licenses requested through the user interface shown in FIG. 3.
FIG. 5 illustrates the transition in a license's status from one category (e.g., "Active," "Replaced," "Revoked with Confirmation," and "Revoked without Confirmation") to another.

FIG. 6 shows a role-entity permission table that is used to assign roles to users.

FIG. 7 shows a license generation request processor and a generic license generator, which are associated with the feature license management module of FIG. 1.

FIG. 8 shows the information flow of sales order information into the feature licensing system.

FIG. 9 shows a user interface presenting a sales order that is undergoing review.

FIG. 10 shows the user interface of FIG. 9 when a change to a sales order is being made.

FIG. 11 shows the manner in which feature credit records are generally associated with customer organization units, which are arranged in a configurable hierarchical structure.

FIG. 12 is a flowchart showing one example of how a customer can provision one or more devices with feature licenses using the feature license system described above.

FIG. 13 shows an example of a product device on which resides a device license module, which serves as an interface through which product devices can perform tasks related to feature licenses.

Summary

In accordance with one aspect of the invention, a system is provided to enable customers to provision devices with feature licenses that enable specified features in the devices. The system includes a feature definition module configured to store product feature information associated with different products available from a plurality of
different manufacturers. At least two of the different products belong to different product lines and support different sets of features. The system also includes a feature license management module configured to generate, update and revoke feature licenses associated with the different products. The feature licenses that are generated all have a common format. The system further includes a feature credit management module configured to monitor and account for feature credits available to customer organization units. The feature credits represent a quantity of a feature that is available to the respective customer organization unit. A user management module is also provided in the system, which is configured to authenticate users of the system. A user interface is accessible over a communications network through which authenticated users can request and receive feature licenses.

[0020] In accordance with another aspect of the invention, a method is provided for provisioning devices with feature licenses that enable specified features in the devices. The method includes authenticating a first customer as an authenticated user and receiving from a first customer over a communications network a first request for a first feature license that includes at least one specified feature. The first request includes an identifier of a first device that is to be provisioned with the feature license. The first device is associated with a first product in a first product line. A second customer is also authenticated as an authenticated user. The first feature license is generated in accordance with a predefined format. A second request is received from a second customer over a communications network. The second request is for a second feature license that includes at least one specified feature. The second request includes an identifier of a second device that is to be provisioned with the feature license. The second device is associated with a product in a second product line different from the first product line. The second feature license is generated in accordance with the predefined format such that the first and second feature licenses have a common format.
**Detailed description**

**Definitions**

[0021] As used herein, the term Generic Product refers to a product that uses the generic feature license format.

[0022] As used herein, the term Non-generic Product refers to a product that does not use the generic feature license format.

[0023] As used herein, the term Feature Qualifier Type refers to one of Boolean type and Integer type.

[0024] The term Feature Qualifier Value refers to a Boolean value that indicates whether a feature is enabled, or a positive integer value that specifies the capacity of a feature (e.g. the number of high-definition channels).

[0025] The term Feature Value Limitation refers to a list or a range of valid feature qualifier values.

[0026] As used herein, the term Feature Type refers to the temporal attribute of a feature and is one of perpetual, subscription and trial.

[0027] The term Feature Dependency refers to the dependencies among multiple features, either due to business rules or hardware limitations. For example, in a product with features A, B and C, feature B and C can only be enabled if feature A is enabled; and feature C cannot have a quantity more than 8 if feature B has a quantity more than 4.

[0028] The term Feature Credit refers to an available quantity of a feature.

[0029] As used herein, the term Feature Credit Record refers to a record that contains the original feature credit established by a feature purchase and the remaining feature credit after a certain quantity of the feature is used. A feature credit record also contains information regarding the organization unit it belongs to.
As used herein, the term Device refers to a physical unit of a product. For a software product, a device is a computer that runs the software.

The term Device ID refers to a unique identifier of a device. If a device does not have an ID, or its ID is not considered secure enough to be used for feature licensing, the device ID may be provided by an expansion module, such as a secure USB token.

The term Secure Device ID refers to a device ID that is not easily modifiable or falsifiable. The threshold of "easily modifiable or falsifiable" is established by manufacturers according to the value of the features in a product.

As used herein, the term Secure Storage refers to a persistent non-volatile memory in a device which is not easily modifiable. The threshold of "easily modifiable" is established by manufacturers according to the value of the features in a product.

As used herein, the term Private Key refers to the private key in an asymmetric cryptographic key pair that is usually used for generating a digital signature for a piece of data.

System Overview

To reduce the cost of developing, maintaining and supporting feature licensing systems, as well as the cost of implementing feature license enforcement mechanism in products, a generic feature licensing system can be provided that can support different product lines, which may include product lines from multiple manufacturers and not just from a single manufacturer. Such a generic feature licensing system may be operated and supported by a third party. Users of such a system may include users associated with the manufacturers, operators of the system who support and maintain the system, and customers who will be using the various features of a product for which licenses are
being obtained. Customers may include, by way of example, service providers and/or the consumer end user.

[0036] Turning now to the figures, FIG. 1 shows the logical architecture of one implementation of a feature licensing system. In this example three categories of users are users 101A-101C (collectively, 101. Users 101A are license users who are representative customers of the feature licensing system such as service providers who obtain products from their respective manufacturers on behalf of end users. Alternatively, the customers may be the end users themselves. Users 101B are manufacturer users who are representative of the manufacturers of the products for which feature licenses are being provided. Users 101C are system support users who are internal system administrative users who belong to the hosting organization that operates and maintains the licensing system. Certain advanced administrative functions may be limited to LAN access only and may not be exposed to a public network.

[0037] The users 101 communicate with the system over the Internet 110 or any other packet-based wide area network. In this example the users access and interact with the system through one or more web servers 120, which provides a single front-end interface that is accessed by a client-based application such as a conventional web browser.

[0038] The feature licensing system typically includes one or more physical server computers with one or more physical storage devices and databases as well as various processing engines. In particular, in the example shown in FIG. 1 the feature licensing system includes one or more service components 130 that typically reside on application servers which execute one or more applications that provide various feature licensing services to the clients 101. In FIG. 1 five logical service components or modules are shown: a feature definition component 131, a feature license management component 132, a feature credit management component 133, a user management component 134 and a non-generic product support module 135
The feature licensing system also includes hardware security modules (HSMs) 145 in which cryptographic keys used to protect licenses may be stored for use by the system. The feature licensing system also contains a database 150 of records. These records may pertain to issued licenses, original requests for new licenses, audit data, control policy information, organization information, project configurations, account relationships, product configurations, user information, and other record types as necessary. The service components have access to user directories 155, which may be the internal enterprise user directories that belong to the various users. The service components also have access to order management systems 165, where sales orders for product features are maintained.

At a high level, the modules that make up the service component 130 provide the following functions and services. The feature definition module 131 stores the product feature information associated with the various product lines of the manufacturers who are supported by the feature licensing system. This module is structured so that it is generic enough to support commonalities among various feature licensing needs. At the same time it is extensible enough to be able to accommodate any peculiarities in the feature specification of certain product lines.

The feature license management module 132 supports routine feature license management tasks such as license generation, updates, enforcement and revocation. This module should be able to carry out such tasks in a generic manner so that it can be shared among different product lines. In addition, because the scale of deployment and the update schedule can vary widely across different product lines, in some implementations the management tasks should support a batch mode of operation.

The feature credit management module 133 obtains feature credit information from customer sales order systems, which manage feature sales orders for the respective customers. This module keeps track of any change in feature credits so that they are accurately accounted for during credit creation and adjustment, as well as license generation, update and revocation.
The user management module 134 integrates with existing user directories of the various users so that the system can be accessed using a single sign-on interface and avoid duplicating user information. This module also manages user privileges so that they are properly authorized to perform certain tasks while being prohibited from performing other tasks.

The non-generic product support module 135 allows legacy products that may be too difficult to migrate to the generic framework to nevertheless be integrated into the feature licensing system. Likewise, certain new products, which for various reasons may not be able to use the generic license format, can also be supported by the feature licensing system.

The licensing system is flexible in its support for products with different levels of computing capabilities, device ID modifiability and storage security, as well as for different needs of license portability.

Another module associated with the system is a device license module, which is located on the product devices. The device license module is responsible for all feature license related operations, such as license validation, feature attribute value reporting, license revocation confirmation generation, etc. It is integrated into product software, which communicates with the module through a programming interface.

**FEATURE DEFINITION MODULE**

The feature definition module 131 stores product feature information that is used for the purpose of feature licensing. This module will typically be used by product team members on behalf of the manufacturer (e.g., by employees of the manufacturer). The feature information that is provided for each product line associated with a manufacturer is composed of the following elements: the product line, the products within that product line, the features associated with that product line, a feature rule set and a default feature rule set.
The product line is specified by a product line name and a description. Each product in a product line includes a product name and description, the name and type of a license signature key (which is stored in an HSM), and a device ID preload flag (which indicates whether device IDs need to be preloaded into the feature licensing system before any license can be generated). Each feature includes a feature ID as defined for a product, a feature part number as defined in a sales order system, a feature name and description, a feature qualifier type, a feature type, and a feature value limitation. A feature rule set specifies feature dependencies within a product. A default feature set specifies the features that make up the essential feature set of a product, and their corresponding feature qualifier values.

The relationship among the aforementioned elements of product feature information for product lines 1 and 2 is shown in FIG. 2. In this example products A and B are associated with product line 1 and product C is associated with product line 2. The feature set for product A includes features 1, 2 and 3, the feature set for product B includes features 3 and 4, and the feature set for product C includes feature 3. As shown, a feature rule set and a default feature set is associated with each product.

In some implementations there may be rules of association among the various elements. For instance, a product will generally belong to one product line, whereas a feature may be associated with one or more products. Likewise, a feature rule set specifies any interdependencies that may exist among features. For example one rule in the rule set may specify that a product may include feature 1 only if the product also includes feature 2. Accordingly, all features specified in a rule set associated with a product must be available for that product. Each product will typically have a default feature set and the features included in the default feature set must be available for that product.

The aforementioned license signature key associated with each product is used to sign feature licenses. Products with asymmetric cryptographic capabilities have an
asymmetric license signature key and products without asymmetric cryptographic capabilities have a symmetric license signature key.

**FEATURE LICENSE MANAGEMENT MODULE**

[0052] In order to support routine feature license management tasks such as license generation, updates, enforcement and revocation, the feature license management module 132 utilizes the format for a generic feature license, which contains the specification of the feature set to be enabled in a particular device. A generic feature license contains the following information: license format version; total length in bytes; sequence number, unique across all licenses generated from the system; product ID used in the system; device ID; secondary device ID, timestamp, time of generation; feature count; list of feature descriptors; signature, by the license signature key of a product; and signature algorithm. The device ID in a license specifies which device the license is for. The secondary device ID is optional and is used when a license needs to be bound to more than one device ID. The binding of a license to the device ID, and optionally the secondary device ID, is protected by the signature in the license, so that a license for one device cannot be used by another device with a different device ID or a different secondary device ID, if any.

[0053] The format of the generic feature license will be applicable across products from different manufacturers, except for non-generic products that already have their own license format before being added to the system and cannot easily adopt the generic license format.

[0054] Each feature descriptor contains the following information concerning the feature with which it is associated: feature ID, as defined for a product; feature qualifier type and value; feature type; expiration date, which is required if the feature type is subscription or trial. The information specified above is forwarded to a generic license generator to generate a feature license file.
[0055] Another aspect of the feature license management module 132 concerns the management of device IDs. Some products’ business process may allow customers to obtain licenses for a specific set of devices. Such products would require device IDs for which licenses could be generated to be imported into the system, as soon as a batch of devices is manufactured and their IDs determined. To satisfy such a requirement, the system has a user interface that allows a user to upload a batch of device IDs in a single file for a specific product.

[0056] The feature license management module 132 also presents a user interface through which a user can request a feature license for a particular product device. One example of such an interface 200 is shown in FIG. 3. After the user logs into the system, the user identifies the product to which the device belongs. In the example of FIG. 3, a pull-down menu 205 is available from which the user may select the appropriate product, which in this case is an Aegis Encryptor v2.3. After identifying the product, the device ID is specified, typically by selecting a preloaded device ID or entering a device ID. In the example of FIG. 3, field 210 is provided in which the user can enter one or more device IDs. In this example two device IDs are entered, IGGA and IGGB. When more than one device ID is specified, the licenses generated for the devices will be identical, except for the device ID and signature.

[0057] After the user has selected a product, the user interface 200 presents a field 215 listing the features which are defined for the specified product and for which the customer currently has available credit. This field also allows the user to specify which features are to be included in the new license and any qualifier values they may have. Finally, after the proper selections have been made the system generates the license, which can then be downloaded by the user. In some cases the user interface supports a batch mode of license generation for when the user needs to generate feature licenses for a large number of devices. In this case the user will generally specify the devices either by selecting many preloaded device IDs, specifying a range of continuous device IDs, or uploading a list of device IDs. Typically the new licenses that are generated in a batch mode will be available to download in a single file. FIG. 4 shows an illustrative user
interface through which the user can download in a batch mode the licenses requested through the user interface shown in FIG. 3.

[0058] Another user interface that is made available by the feature license management module 132 allows users to generate a replacement license for a device for the purposes of renewing, adding and/or removing various features, and/or for changing the qualifier value and expiration date of features that are currently present in the device. This user interface may be similar to that shown in FIG. 3, except that it will present the device's existing feature information in its most current feature license. It will also allow modifications to be made to the existing feature set so that a new license can be generated and downloaded. Once again, this user interface may operate in a single device mode or a batch mode, which can be used for multiple devices which have the same current feature set.

[0059] The feature license management module 132 also allows users to revoke a license, which occurs when a device's feature license needs to be replaced or removed. Upon revocation, the device generates a revocation confirmation file. When a revocation confirmation file for a device is uploaded into the system, the feature credits used by the features in the revoked license may be reclaimed, if allowed by the business process of the related product. A revocation confirmation file may contain the following information; the format version of the revocation confirmation file; the device ID and the product ID of the device whose license is being revoked; the sequence number of the license being revoked; a hash of the license being revoked; a timestamp, denoting the time of revocation; a signature and signature algorithm.

[0060] A user interface is provided to which the revocation confirmation file from a device can be uploaded into the system by a user. Alternatively, the revocation confirmation file from a device can be uploaded into the system by the device itself through an automated interface of the system, directly or indirectly. The information in the revocation confirmation file is used to correctly set the current license status and
adjust feature credits as necessary. The user interface may support a batch mode for uploading multiple revocation confirmation files, which may be packaged in a single file.

[0061] The status of a feature license at any time falls into one of four categories: "Active," "Replaced," "Revoked with Confirmation," and "Revoked without Confirmation." The transition of a license's status from one category to another is illustrated in FIG. 5.

[0062] When a feature license is newly generated, its status is "Active". When an existing feature license is replaced by a new license with a different feature set, the status of the original license becomes "Replaced". This transition is indicated in FIG. 5 by the arrow from the "Active" state to the "Replaced" state. When a license is replaced the user takes the new license and installs it in the device. During the installation process, a revocation file is generated by the device and uploaded to the system by a user. At this time the status of the old license becomes "Revoked with Confirmation." If a functioning device is being decommissioned its license needs to be revoked without generating a replacement. This triggers the transition of the license directly from the "Active" state to the "Revoked with Confirmation" state. If on the other hand a device is inoperable, its license may be "Revoked without Confirmation," and thus there is a transition shown in FIG. 5 from "Active" directly to "Revoked without Confirmation". Finally, the transition shown in FIG. 5 from the "Replaced" state to the "Revoked without Confirmation" state is triggered when a new license is generated but the revocation confirmation is lost and thus not received by the system.

**DEVICE LICENSE MODULE**

[0063] A device license module resides on the product devices and serves as an interface through which product devices can perform tasks related to feature licenses. FIG. 13 shows an example of a product device 610 on which such a device license module 620 is located. The module 620 has an interface 630 which is configured as an application programming interface (API) that resides on the product devices and communicates with
the software 640 residing on the device 610. The tasks performed through such an interface relate generally to license enforcement and may include loading of the initial license, along with its validation, license replacement, with validation of the new license and generation of a revocation confirmation file for the old license. Additional tasks may include license removal, with generation of a revocation confirmation file for the removed license, a license presence check, a query for feature types and the feature qualifier value for a specific feature.

[0064] When validating a feature license, a device verifies a number of items including for example, the signature of the feature license, the product ID in the license (which should match the device's own product ID) and the device ID in the license (which should match the device's own device ID). The device may also verify that the timestamp in the license is not for a time in the future (to prevent clock rollback on the device). Likewise, when replacing an existing feature license, the validation process may also include a verification of the new license's sequence number to ensure that it is larger than the old license's sequence number.

**USER MANAGEMENT MODULE**

[0065] Various users of the system such as manufacturers and service providers may have internal infrastructure that includes enterprise user directories to authenticate users such as employees and the like. These enterprise user directories are often based on standard user directory databases such as the lightweight database access protocol (LDAP), for example. When possible, the user management module 134 integrates with these directory databases so that users can be easily authenticated.

[0066] Users who already have an entry in a user directory will register with the feature licensing system. During the registration process using the module 134, the user selects the particular user directory in which the user already has an entry. The system verifies the registration with the user directory and requests a system administrator to approve the registration. A system administrator can either reject or approve a user registration request. When approving a user registration, a system administrator also assigns a proper
role or roles to the user. Once a user's registration is approved, and proper access privileges are assigned to the user, the user can log into the feature licensing system as an authenticated user. Users who do not already have an entry in an integrated user directory will need to create such an entry and then go through the above-mentioned registration and approval process to gain access to the feature licensing system.

[0067] The user management module 134 also manages and controls the roles assigned to users. That is, the module implements role-based access control so that users may be authorized to perform certain user actions and prohibited from performing other user actions. A user role is combined with a scope to limit the kinds of entities on which a user can carry out the tasks of the roles assigned to the user. For instance, a user assigned with the "Administrator" role and the "Company" scope can perform administrative tasks on companies, whereas a user assigned with the "Administrator" role and the "Site" scope can perform administrative tasks on sites. To further limit which exact entity a user can act on, a user may be assigned to a specific set of entities. For example, a user with the "Administrator" role and the "Site" scope may be assigned to Site A and Site B, enabling the user to perform site administrative tasks on Site A and Site B; whereas another user with the same role and scope may be assigned to Site C and Site D, enabling this user to perform site administrative tasks on Site C and Site D, but not Site A nor Site B.

[0068] Not every user role is meaningful for every type of entity. For instance, a user can be assigned the role of "Product Manager" for a specific product, making the user capable of modifying product information associated with that product. This role is not meaningful for a customer entity, because product information maintenance has nothing to do with customers. To define which roles are meaningful for which types of entity, a role-entity permission table, as illustrated in FIG. 6, may be maintained to prevent roles which are not meaningful for certain types of entities from being assigned to users associated with those entities. The user management module 134 uses the permission table to manage user roles so that improper roles are not assigned.
NON-GENERIC PRODUCT SUPPORT MODULE

[0069] Each non-generic product has its own license generator that implements the product's proprietary license generation mechanism. The non-generic product support module 135 provides an adapter for each of these non-generic license generators. The adaptor converts a generic license generation request to a request that is compatible with the non-generic license generator. A non-generic product record is maintained in the system and contains the information required by the product's license generator adapter, so that when a feature license for a non-generic product needs to be generated, the product's license generator adapter can be located and used.

[0070] FIG. 7 shows a license generation request processor 310 and a generic license generator 320, which are associated with the feature license management module 132 of FIG. 1. When a license for a generic product or product line is to be generated, the license generation request processor 310 sends a list of requested features and other necessary information to the generic license generator 320 so that the license can be generated. Also shown in FIG. 7 are non-generic license generators 330i, 3302, … 330n, each of which is used to generate a license for a non-generic product or product line. An adaptor 340i, 3402, … 340n is provided for each of the non-generic license generators 330i, 3302, … 330n. The adaptors receive requests from the license generation request processor 310 and, using information from the non-generic product support module 135, translate them into a format that allows the non-generic license generators 330i, 3302, 330n to generate the non-generic licenses.

FEATURE CREDIT MANAGEMENT MODULE

[0071] A customer's entitlement to product features is established by sales orders for those features. That is, a customer purchases product features, often by submitting a purchase order to a manufacturer, and the purchased features are recorded in a sales order by the manufacturer. The feature licensing system can automatically acquire the pertinent sales order information in the manner described below and assign the appropriate feature credits to the customer.
Sales orders of a manufacturer are usually managed by a sales order system used by the manufacturer. The information flow of sales order information into the feature licensing system is illustrated in FIG. 8. FIG. 8 shows sales order systems 410, 410, ..., 410, which are each associated with a manufacturer. The feature credit management module 133 includes a sales order retriever 420, which periodically searches the sales order systems 410 for new sales orders that contain line items for feature part numbers that are stored by the feature definition module 130. In FIG. 8 feature definition module is represented by feature definition store 430, which stores the product feature information that is used for the purpose of feature licensing.

When the sales order retriever 420 finds a new sales order for a feature defined in the system, it retrieves a copy of the order, which includes the sales order number, sales order line item number, feature part number and the ordered quantity. The sales order retriever 420 also copies the customer information related to such orders, including the customer organization unit against which the resulting feature credits should be charged, to a customer information store 440. The identity of the sales order system from which the sales order was retrieved is kept together with the sales order information and customer information retrieved from that system, so that such information can be traced back to its source.

The sales order retriever 420 also transfers the sales order to an accepted sales order store 450, which creates a corresponding feature credit record that is transferred to feature credit store 470. Optionally, instead of sending the sales order directly to the accepted sales order store 450, the sales order retriever 420 may transfer the sales order to a pending sales order store 460, where it is held until it can be reviewed by a user who has intimate knowledge of the product, related products, the customers associated with the product and their sales orders. This manual review step can prevent incorrect data from entering the feature licensing system. The user who reviews the pending sales orders can either accept or reject individual line items in the sales order. This same user can choose to change a line item’s quantity and the customer organization unit the line item is associated with. The user may be required to enter a specific reason for each
change that is made. When a line item is accepted, it is then transferred to the accepted sales order store 450. FIG. 9 shows a user interface presenting a sales order that is being reviewed and FIG. 10 shows the user interface when a change is being made.

[0075] The system allows the manual sales order review step to be turned on or off for a product or product line. In general, products or product lines with a simple feature set and often simple sales orders may not have many errors in the sales orders and hence may not require such a manual sales order review step.

[0076] When the quantity of a line item is negative, as in a credit or a return line item, the quantity of the corresponding feature credit record in the accepted sales order store 450 will also be negative. Such a negative feature credit quantity reduces the total available credit for a feature.

[0077] In some cases, there may be a need for adjusting a feature credit without a sales order. In some cases the system may allow authorized users to make changes to the available quantity in a feature credit record. When adjusting a feature credit, the user may be required to enter a specific reason for the adjustment, which is logged as part of the adjustment action.

[0078] Feature credit records are generally associated with customer organization units. All the organization units of a customer are maintained in a configurable hierarchical structure, which mimics the usual organizational structure of a company, as illustrated in FIG. 11.

[0079] The total quantity of a feature available to a certain customer organization unit depends on the feature credit accounting rule established for the customer and the feature's product. The rule can allow the calculation of the total available quantity of a feature to include feature credit records associated with all the organizational units of customer or a subset of the customer organization units. For instance, the total available quantity of a feature may be associated with each individual organization unit, an individual unit and all higher level units in the organization's hierarchy, all other
organization units at the same hierarchical level of a particular unit, or all the organizational units of the same customer.

[0080] When a new feature license is generated, the quantity of an included feature is deducted from one or more feature credit records that are included in the credit availability calculation. The relationship between a feature license and the feature credit records from which the feature was deducted may be logged for future reference.

[0081] When a replacement feature license is generated, the increased quantity of a feature in the old license and the quantity of a newly included feature are deducted in the same way as described above. However, a decreased quantity of a feature in the old license may not be returned immediately. Only when a license's revocation confirmation is received is the quantity of each feature in the license returned to the feature credit records from which it was deducted. This applies to both replaced and revoked licenses and occurs when the license status changes from "Active" or "Replaced" to "Revoked with Confirmation".

SUPPORT FOR DIFFERENT LEVELS OF PRODUCT CAPABILITY AND LICENSE PORTABILITY

[0082] The system has the flexibility to support products with different capabilities and different license portability requirements. In general, for a product to support feature licensing, there are two basic security requirements:

[0083] 1. Each device needs a unique secure device ID that is not easily modifiable or falsifiable by an end-user. This ID is included in a feature license to bind it to a device.

[0084] 2. Each device needs a secure storage unit that can be used by the feature licensing component on the device. "Secure" means that the storage unit is not easily modifiable by an end-user. The licensing component will store the license state in this storage area. The license state typically refers to the license itself. However, at a
minimum, the license state may simply be the global license sequence number of the license that is currently loaded. Storage of the license state prevents roll-back of the current license to a previous license which may entitle the device to more features than the current license.

[0085] If a product does not meet either or both of these requirements, alternative mechanisms can be used. Such mechanisms include external security devices that have a secure ID and a secure storage, and may have a private key embedded in them, for instance, smart cards and USB security tokens (i.e. crypto tokens) or other types of external security tokens. When connected to a device that needs a feature license, such an external security device provides the necessary secure ID to bind the feature license as well as the necessary secure storage to store the license state.

[0086] Even if a product meets both security requirements, the product may not have enough computing power or necessary data (such as a private key) to perform all computations related to feature licensing, and thus may still need an external security device to perform those computations. In addition, a product that meets both security requirements may require its feature licenses to be portable from one device to another. A feature license bound to the ID of an external security device can provide this kind of license portability.

[0087] For purposes of illustration the following discussion will assume that crypto tokens are being used.

[0088] Products can be classified into four categories according to which of the two requirements they meet. The four cases will be discussed in turn.

[0089] In the first case, the product has both a secure device ID and a secure storage. If a crypto token is used with a device for license binding, license storage, as well as license revocation confirmation signing (by the cryptographic key embedded in the token), the system may support either "portable" or "non-portable" token scenarios. A portable token has a license that is bound only to the token's ID but not the device's own ID (as the
secondary device ID in a license), and allows end-users to use the token in any device of the product. A non-portable token has a license that is bound to both the token's ID and the device's own ID, and thus can only be used for the device. If, on the other hand, a crypto token is not used, and each product device has a device-specific private key, this private key may be used to sign a license revocation confirmation. This provides better security but requires device personalization to load the device-specific private key and a certificate onto the device. If a crypto token is not used, and each product device does not have a device-specific private key, then the license revocation confirmation can be signed with a derived symmetric key. This provides lower security but does not require device personalization.

[0090] In the second case, the product has a secure device ID but not a secure storage. If in this case a crypto token is used the license file can be stored on the token and the license revocation confirmation is signed with the private key on the token. Similar to the first case, either "portable" or "non-portable" token scenarios can be supported in the second case. If on the other hand, a crypto token is not used, then as in the first case, either a device-specific private key or a derived symmetric key can be used to sign a license revocation confirmation, but with lower security than in the first case where a crypto token is not used.

[0091] In the third case, the product has secure storage but not a secure device ID. If this product supports device personalization, a unique device ID can be loaded into the secure storage, converting this case into the first case. If device personalization is not available and a crypto token is used, the license file can be stored on the token and the token's own ID can be used as the secure device ID for license binding, in which case the token is inherently portable. In addition, confirmation of a license revocation can be signed with the private key on the token. On the other hand, if device personalization is not available and a crypto token is not used, then the confirmation of a license revocation can be signed with a derived symmetric key.
In the fourth case, the product has neither a secure storage nor a secure device ID. If in this case a crypto token is used, the license file can be stored on the token and the token's own ID can be used as the secure device ID for license binding, in which case the token is inherently portable. In addition, confirmation of a license revocation can be signed with the private key on the token. If crypto token is not used and each product device does not have a device-specific private key, then the license revocation confirmation can be signed with a derived symmetric key.

**EXAMPLE**

FIG. 12 is a flowchart showing one example of how a customer can provision one or more devices with feature licenses using the feature license system described above. The method begins in step 505 and continues to step 510 where customer remotely logs into the system using a web browser interface. The system verifies the customer's credentials through a user directory associated with the customer's organization. Once the customer has been properly authenticated the system displays or otherwise presents to the customer in step 515 a list of products for which this customer has feature credits available. In response, the customer selects a product to which the device(s) being provisioned belongs in step 520. The system then displays for the user in step 525 a list of features available for the selected product. Also presented may be the number of feature credits available for that product, and any feature qualifiers or other attributes that may be associated with the features. Next, in step 530, the customer enters one or more device IDs to identify the devices to be provisioned and in step 535 selects the desired features from the available features and specifies the value of any attributes of the selected features. The system presents the customer with a summary of the requested items and the customer confirms the selections in step 540. The system then generates the licenses in step 545 and makes them available so that the customer can download them in step 550, either in a single file or in separate files. The licenses that are generated all contain the same set of features and attribute values, which correspond to those selected by the customer.
As used in this application, the terms "component," "module," "system," "apparatus," "interface," or the like are generally intended to refer to a computer-related entity, either hardware, a combination of hardware and software, software, or software in execution. For example, a component may be, but is not limited to being, a process running on a processor, a processor, an object, an executable, a thread of execution, a program, and/or a computer. By way of illustration, both an application running on a controller and the controller can be a component. One or more components may reside within a process and/or thread of execution and a component may be localized on one computer and/or distributed between two or more computers.

Furthermore, the claimed subject matter may be implemented as a method, apparatus, or article of manufacture using standard programming and/or engineering techniques to produce software, firmware, hardware, or any combination thereof to control a computer to implement the disclosed subject matter. The term "article of manufacture" as used herein is intended to encompass a computer program accessible from any computer-readable device, carrier, or media. For example, computer readable storage media can include but are not limited to magnetic storage devices (e.g., hard disk, floppy disk, magnetic strips . . . ), optical disks (e.g., compact disk (CD), digital versatile disk (DVD) . . . ), smart cards, and flash memory devices (e.g., card, stick, key drive . . . ). Of course, those skilled in the art will recognize many modifications may be made to this configuration without departing from the scope or spirit of the claimed subject matter.
Claims:

1. A system to enable customers to provision devices with feature licenses that enable specified features in the devices, comprising:

   a feature definition module configured to store product feature information associated with different products available from a plurality of different manufacturers, wherein at least two of the different products belong to different product lines and support different sets of features;

   a feature license management module configured to generate, update and revoke feature licenses associated with the different products, wherein the feature licenses that are generated all have a common format;

   a feature credit management module configured to monitor and account for feature credits available to customer organization units, said feature credits representing a quantity of a feature that is available to the respective customer organization unit; and

   a user management module configured to authenticate users of the system; and

   a user interface accessible over a communications network through which authenticated users can request and receive feature licenses.

2. The system of claim 1 further comprising a non-generic product support module for supplying product feature information to a license generator that generates feature licenses that do not conform to the common format.

3. The system of claim 1 wherein the feature license management module is further configured to present to the authorized users through the user interface a list of pre-
loaded device IDs such that features licenses can be requested for devices corresponding to one or more of the pre-loaded device IDs selected by the authorized users.

4. The system of claim 3 wherein the feature license management module is further configured to generate the feature licenses requested for the devices corresponding to the one or more of the pre-loaded device IDs only if the feature credit management module indicates that sufficient feature credits are available.

5. The system of claim 1 wherein the product feature information associated with the different products includes a feature qualifier associated with each feature, said feature qualifier having a type of either Boolean or integer, said feature qualifier having either a Boolean value specifying whether the feature is enabled or an integer value specifying a capacity of the feature.

6. The system of claim 1 wherein the user interface is configured to receive from the authorized users requests for feature licenses for a plurality of devices in a batch mode of operation.

7. The system of claim 1 wherein the product feature information includes a feature rule set specifying feature dependencies among features that are available for a particular product.

8. The system of claim 1 wherein the user management module is further configured to access enterprise user directories in order to facilitate identification of authorized users.

9. The system of claim 1 wherein the user management module is further configured to implement role-based access control combined with access scope and specific entity assignment so that authorized users are authorized to perform selected actions on specific entities and prohibited from performing other actions or acting on unassigned entities.
10. The system of claim 1 wherein the feature credit management module includes a sales order retriever for retrieving sales order information from manufacturers to record feature credits available to customers for specified products and features.

11. A method for provisioning devices with feature licenses that enable specified features in the devices, comprising:

   authenticating a first customer as an authenticated user;

   receiving from a first customer over a communications network a first request for a first feature license that includes at least one specified feature, said first request including an identifier of a first device that is to be provisioned with the feature license, said first device being associated with a first product in a first product line;

   authenticating a second customer as an authenticated user; and

   generating the first feature license in accordance with a predefined format;

   receiving from a second customer over a communications network a second request for a second feature license that includes at least one specified feature, said second request including an identifier of a second device that is to be provisioned with the feature license, said second device being associated with a product in a second product line different from the first product line;

   generating the second feature license in accordance with the predefined format such that the first and second feature licenses have a common format.

12. The method of claim 11 wherein devices in the first product line are available from a first manufacturer and devices in the second product line are available from a second manufacturer different from the first manufacturer.

13. The method of claim 11 further comprising receiving from the first customer an identifier of the first product and in response presenting a user interface to the first user
for the product that includes a list of available features for the product, a feature qualifier
value for each feature and a feature credit value specifying a number of units of each
feature that is available to the first user.

14. The method of claim 11 further comprising revoking the first license and
replacing it with an updated license and receiving a confirmation of revocation from the
first device.

15. The method of claim 11 wherein authenticating the first customer includes
accessing an enterprise user directory of an organization with which the first user is
associated.

16. The method of claim 12 further comprising searching a sales order system of the
first and second manufacturers to identify and retrieve a sales order with a feature part
number associated with a feature available for either the first or second product and
allocating feature credit values to a customer who placed the sale order.

17. The method of claim 11 wherein the feature credit values are allocated in
accordance with a feature credit accounting rule predefined for the customer so that the
feature credit values are available to selected organizational subunits of the customer.

18. The method of claim 11 further comprising:

receiving from a third customer a third request for a third feature license; and

in response to the third request, supplying product feature information to be included in
the third license to a non-generic license generator, wherein the non-generic license
generator generates the third license in accordance with a format that does not conform to
the predefined format.
19. The method of claim 11 further comprising downloading the first feature license to the first device for installation thereon by a device license module that validates and enforces the first feature license.

20. The method of claim 11 further comprising downloading the first feature license to an external security token having a secure ID and being configured to store the first feature license and bind the first feature license thereto.

21. The method of claim 20 wherein the external security token is a portable token in which the first feature license is bound to the secure ID but not an ID of the first device.

22. The method of claim 20 wherein the external security token is a non-portable token in which the first feature license is bound to the secure ID and an ID of the first device.

23. The method of claim 20 wherein the external security token includes a cryptographic key for performing license revocation confirmation signing.
FIG. 2
FIG. 5

FIG. 6
<table>
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<th>SALES ORDER NUMBER</th>
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**Toolbox**

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</table>
FEATURE LICENSE GENERATION

START

CUSTOMER USER LOGS IN

SYSTEM DISPLAYS PRODUCTS FOR WHICH THE CUSTOMER USER HAS FEATURE CREDIT

CUSTOMER USER SELECTS A PRODUCT

SYSTEM DISPLAYS A LIST OF FEATURES OF THE PRODUCT

CUSTOMER USER ENTERS ONE OR MANY DEVICE IDS

CUSTOMER USER SELECTS PRODUCT FEATURES AND SPECIFIES THEIR ATTRIBUTES

CUSTOMER USER CONFIRMS DEVICE ID(S), FEATURE SELECTION AND FEATURE ATTRIBUTE VALUES

SYSTEM GENERATES ONE OR MANY LICENSES

CUSTOMER USER DOWNLOADS ONE OR MANY LICENSES

END

FIG. 12