A flexible mobile telephone management system utilizes a mobile telephone that includes a mobile handset, with electronics implementing a wireless communications terminal function, and an embedded micro-controller system including memory and a firmware program. The firmware program implements a plurality of executable call management routines that can generate and store descriptive data of the operation of the mobile telephone. The micro-controller is coupleable to a host computer system for the exchange of the descriptive data and mobile telephone configuration data. The host computer system provides the configuration data to select a predetermined one of the executable call management routines for execution by the micro-controller and to, in turn, provide the descriptive data. Further, the configuration data may be specified by the host computer system to selectively enable a set of two or more of the executable call management routines for execution by the micro-controller. In addition, the configuration data may be used to qualify the execution of the call management routines and to determine, at least in part, the content of the descriptive data collected by the micro-controller system. The configuration data may also contain a predetermined collection of data that is then available for reference in the execution of the executable call management routines.
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CALL COST MANAGEMENT AND BILLING CONTROL
INTEGRATED WITH A MOBILE TELEPHONE

Inventors:

Gordon C. Collett
Gary A. Gale

Background of the Invention

Field of the Invention:

The present invention is generally related to general cost control and billing programs that are used in accounting for communication service management, such as among mobile telephone systems and networks, including cellular telephone services, Personal Communication Services, or PCS™, and other such mobile wireless telephone systems (collectively referred to as mobile telephone systems), and, in particular, to a system of tracking, accessing, and controlling mobile telephone calls on a real-time basis including managing the costs and providing the ability to bill the costs to an account, budget or project.

Description of the Related Art:

At present, most mobile communication costs are determined from the monthly billing statement received from the mobile telephone service provider or carrier. These bills normally show the number that was
dialed, duration of the call, and cost of the call for each call made over the system in the previous month. This monthly bill provides information that can be used to determine a name associated with the dialed number, but it is usually very difficult for the telephone users to try to remember all of these calls. This is especially true if the desired information must include the actual party finally reached through the dialed number, the reason for calling, what account, budget, or project should be billed for the call, and how much to bill for the call. Thus, monthly billing statements provide very little of the total information needed for either billing programs or accounting programs to associate communication costs on an accounting basis.

Another problem with monthly billing statements is the inability to control mobile telephone costs. It is very difficult to control costs generated by telephone users after the calls have been made. A single user can generate considerable call costs before monthly bills are received and evaluated and the misuse of cellular telephones is a major problem for public or private organizations, especially those using a large number of mobile telephones.

Another problem with this billing process occurs when the mobile telephone is being provided to a user on a temporary basis such as renting the telephone. The normal rental process should generate an immediate receipt when the telephone is returned showing the calls made, the information pertaining to those calls, such as but not limited to dialed number, call duration, date and time. This not only provides a receipt to the user for the bill, but allows the telephone provider to immediately bill the customer for effective cash flow. If the calls cannot be evaluated until
the monthly bill is received, immediate customer billing, or real-time receipts, are not possible.

Various systems have been created to try to solve some of these problems. One such system is known as the "debit" or pre-paid telephone system. In use, a customer pays the telephone provider in advance for a set number of minutes of telephone usage. Special cellular telephones are created that allow for the storage and tracking of per-minute usage and deactivate the telephone if the maximum minute usage is reached, regardless of the actual costs involved. The customer must pay the provider an additional amount to "reset" the telephone for additional usage minutes. This type of debit cellular telephone usage system is described in a patent issued to Telemac Cellular Corporation, entitled Mobile telephone With Internal Accounting, U.S. Patent Number 5,577,100.

Telemac Cellular Corporation is also the assignee of two other patents relating to the storage of a limited amount of call information in a cellular telephone with the capability to download this information to a central computer for processing real-time call information for cellular telephone rental systems. U.S. Patent Number 5,625,669, entitled Mobile telephone With Internal Call Accounting Controls, describes a system that only supports connection of a single telephone at a time to a central terminal to download stored call information. U.S. Patent Number 5,325,418, entitled Cellular telephone Accounting System, relates to the same type of cellular telephone system, but allows connection of multiple telephones over multiple terminals simultaneously.

In each of these systems, the mobile telephones record and store the immediate event information available at the time a call is made. The
telephones store the call time and date, called telephone number, and call duration as the event, and the data related to the event. Given the system design goal of supporting the "debit" approach to billing, these systems are fully competent for their intended use: the rental of mobile telephones for short term or temporary use. And conventionally, the pre-pay approach in rental transactions is generally preferred as it permits the payment to be pre-qualified and, in-effect, guaranteed.

There are, however, a substantial number of business, or at least business related, usage circumstances where a pre-pay or time-accounting only approach, or both, is not appropriate, desirable, or adequate for fully accounting for the use of a mobile telephone and, in connection with the accounting, limiting use in some reasonable fashion. While the addition of space for the storage of more information in a cellular telephone may be comparatively easy, the acquisition of information remains problematic. Since the use of any cellular telephone will be quite varied in the many different non-rental circumstances of use, the centralized programming of the cellular telephones is generally perceived as too limiting for practical use. On the other hand, the effective user interface of a cellular telephone is far from being efficient for the entry of extensive or complex information. Consequently, there does not presently exist a system for managing or controlling the use of cellular telephones in a wide variety of business and business related circumstances.

Summary of the Invention

A general purpose of this invention is to enable a mobile telephone to operate and, with associated central station computer software, be
reconfigurable to operate in a number of different roles that permit a variety of different cost management, accounting, and usage control objectives as may occur in diverse circumstances.

This is accomplished by the present invention by providing a mobile telephone that includes a mobile handset, with electronics implementing a wireless communications terminal function, and an embedded microcontroller system including memory and a firmware program. The firmware program provides for the storage of a plurality of function profiles, with each of the function profiles defining a respective predetermined set of enabled functions out of a set of enableable functions implementable by the execution of the firmware program. The firmware program further supports programmable selection of a predetermined one of the function profiles and thus define the function of the mobile handset.

The present invention may also provide for the mobile telephone to operate as part of a mobile telephone management system that further includes a host computer system including a data transceiver and a predetermined application program executable by the host computer system. The firmware program implements a plurality of executable call management routines that can generate and store data descriptive of the operation of the mobile telephone. The micro-controller system is coupleable to the host computer system for the exchange of the descriptive data and mobile telephone configuration data. The host computer system provides the configuration data to select a predetermined one of the executable call management routines for execution by the micro-controller and, in turn, to provide the descriptive data. The configuration data may further be specified by the host computer system to selectively enable a set
of two or more of the executable call management routines for execution by the micro-controller system. Further, the configuration data may be used to qualify the execution of the call management routines and to determine, at least in part, the content of the descriptive data collected by the micro-controller system. The configuration data may also contain a predetermined collection of data that is then available for reference in the execution of the executable call management routines.

Thus, an advantage of the present invention is that a mobile telephone, implementing the present invention, can be configured to variously provide access to different telecommunications functions and features and to collect information descriptive of how such functions and features are use.

Another advantage of the present invention is that the operation of the mobile telephone can be configured and controlled through a base station that executes an application program. This application program performs the dual function of supporting the selection and programming of configuration data into a mobile telephone and retrieving and processing the descriptive data into a form that is usable, particularly as a business report of the mobile telephone’s usage.

A further advantage of the present invention is that the configuration data can be used not only to enable particular telecommunications functions of the mobile telephone, but also to tailor the particular executed implementation of such telecommunications functions. This tailoring may be chosen to correspond, for example, to the particular mission objectives of the mobile telephone’s subsequent use, to the requirements of a particular user, or the constraints defined by the owner or operator of the mobile telephone.
An additional advantage of the present invention is that the configuration data may also be used to tailor the collection of the descriptive data collected. Thus, the desired accounting of the use of the mobile telephone is flexibly definable in conjunction with the selected enablement and qualification of the available telecommunications functions implemented by the mobile telephone.

Yet another advantage of the present invention is that the collection of the descriptive data occurs in real-time with respect to the real-time use of the mobile telephone. All data that can be collected automatically, such as called number and duration, is collected transparently to the user. The collection of additional data, such as the actual called party, can be selectively enforced in real-time through qualification of the execution of the various telecommunications functions, i.e., use is permitted only if some minimum set of additional data determined by the configuration data is entered through the telephone keypad. Such real-time enforced collection of data results in the acquisition of a most detailed and comprehensive data-set, which is then available subsequently for analysis and reporting by the call management base station.

Still another advantage of the present invention is that the collection data may be augmented by the inclusion of, for example, various mission specific and user specific collections of information in the configuration data programmed into the mobile telephone. These collections of data can thus be accessed in real-time within the mobile telephone to supplement, add to, and qualify the collected data. For example, the collections of data may include telephone number/called party lists, billing account lists, billing category lists, and the like that can be accessed in combination and in real-time to provided detailed descriptive data that is
then stored by the mobile telephone for subsequent processing by the base station.

A yet further advantage of the present invention is that only modest requirements are placed on the design of conventional mobile telephones in order to support the implementation of the present invention.

**Brief Description of the Drawings**

These and other advantages and features of the present invention will become better understood upon consideration of the following detailed description of the invention when considered in connection with the accompanying drawings, and wherein:

Figure 1 shows the basic structure of a mobile telephone with the capabilities for function, application, and user profile loading; Debit/Pre-Paid, Rental and Call Management call information storage; Program operation with User/Phone Command Interface; and Local/Remote DTMF communication with a computer;

Figure 2 shows the local communication link between the mobile telephone and a computer using the telephone’s peripheral port connected directly to the computer’s RS-232 serial data port via a data cable, or by placing the telephone into a base unit that connects between the telephone’s peripheral port and the computer;

Figure 3 shows the remote communication link between the telephone and the computer using the DTMF or touch-tone signaling capabilities within the telephone;
Figure 4 shows the telephone equipped with a modem for remote information downloading and/or programming instead of using the DTMF transceiver and the link to the computer;

Figure 5(a) is a block diagram of a function profile download from the computer to the mobile telephone;

Figure 5(b) shows the details for a Debit/Pre-Paid call function profile, while Figure 5(c) shows the details for a rental function profile and Figure 5(d) shows the details for a call management function profile;

Figure 6(a) is a block diagram of a call management application profile download between the computer and the mobile telephone which shows the details for the call management application profile of tracking and controlling mobile call usage;

Figure 6(b) shows the details of a call management application profile for billing calls such as in legal applications;

Figure 7 is an example of a user profile structure under the call management function;

Figure 8 (a-g) demonstrates the user command structure for operation of the telephone under the call management function, and wherein Figure 8(a) shows the basic mobile telephone display, Figure 8(b) shows dialing the telephone using the two-digit index code, Figure 8(c) shows dialing the telephone in the normal method of entering a number and pushing the SEND key, Figure 8(d) shows dialing the telephone from the call management telephone directory while Figure 8(e) shows dialing from the telephone directory with online edit of caller name or billing category, Figure 8(f) shows incoming call classification utilizing the telephone directory or user provided information, and Figure 8(g)
shows manually adding information to the telephone if allowed by the
user profile;

Figure 9 is a flow chart of the function profile download software
running on the computer; and

Figure 10 displays the structure of the call management software
that loads the application and user profiles into the telephone and
generates the call reports from the information downloaded from the
telephone.

Detailed Description of the Invention

The present invention provides for a comprehensive call
management system that is particularly suited for managing the use of
mobile telephones. In order to provide call management, the present
invention effectively implements a true call cost and billing system that
operates directly and in real-time to gather the substantial additional
information necessary to support true call cost billing. This additional
information, while gathered in real-time is, in accord with the present
invention, then stored into the mobile telephone pending subsequent
upload to a base computer system for detailed analysis and processing
as necessary or appropriate for billing costs based on the actual use of
the mobile telephone.

The present invention also recognizes and addresses the need or
at least desire to enable a particular mobile telephone to be programmed
in a number of different ways, thus operate in a number of different roles,
depending upon differing requirement for internal call accounting, the
mission use of a particular mobile telephone, and the nature or activity of
the person that is using the mobile telephone. For example, a lawyer using a mobile telephone to track client calls for direct billing purposes might use the telephone and supported accounting functions in a much different way than when a mobile telephone is checked out to a Government employee to use for official business. Where the lawyer would probably require a substantial degree of flexibility in how calls are recorded for accounting costs to a client, the Government employee would likely be subject to cost controls that must be firmly fixed, down to the level of whether personal or business calls are being made and to what internal budget account and category each call will be incurred against.

Other types of billing applications may require entirely different operational structures. Mobile telephones are widely used by public agencies such as police departments, but at present there is no capability to control the telephone usage or to associate telephone usage to a particular person, department or budget. In many cases, local governments have disallowed mobile telephone usage for this reason, but that is not an acceptable solution.

Thus, the present invention provides for a mobile telephone that can control its own usage as well as associate each call to a particular budget category. In doing so, in a preferred embodiment of the present invention, a new hierarchical data structure is used to track multiple sets of information internal to the mobile telephone. First, to control telephone usage, the mobile telephone is provided with the capability to associate calls with specific categories of call, simplistically such as between “allowed” business or agency calls and personal or unauthorized calls. Categories of calls are, in turn, associated with usage limitations so that possibly a certain amount of personal calls would be accepted, but the
usage limited to some preset amount, perhaps identified as some combined duration of local and long distance calls, whereas business or agency related calls might have no such duration restrictions. Conversely, however, any business or agency can additionally require that the call be associated with a particular budget, department or project before the call is actually dialed.

An existing mobile telephone design, or one modified to implement the present invention, can be set up to support any number of possible functions by loading a telephone function profile into the executable memory space of the telephone. This function profile not only includes support for all of the necessary normal telephone operations, but also adds or enables features to implement the present invention. For instance, a mobile telephone configured with a particular function profile may configure the mobile telephone to be a debit/pre-paid mobile telephone, a rental mobile telephone or a call cost management and billing controlled mobile telephone. The chosen mobile telephone role can be subsequently changed or modified as determined by the then downloaded function profile.

The debit/pre-paid role would enable a mobile telephone of the present invention with the capability to self-deactivate unless and until activated or reactivated by the base station computer software. In this case, a customer for the mobile telephone would pay in advance for a set amount of telephone usage. The telephone, when activated, keeps track of each call into or out of the telephone, its duration and its type, i.e., local, roaming (operation out of the local mobile telephone service area), long distance or international. An internal mathematical algorithm computes the dollar amount spent for each call and compares it to the
pre-paid amount originally purchased. When the maximum amount is reached, the telephone is deactivated until more time is purchased. Any dialing restrictions such as international dialing may also be programmed into the telephone as part of the function profile.

A second role type is that of a rental mobile telephone. Here the telephone is programmed with the capability to track the time, date, duration, called number if an outgoing call, or caller ID for an incoming call, and call type (local, roaming, long distance, or international) for each call made by or to the mobile telephone. In this role, the mobile telephone user has rented the telephone instead of pre-paying for time. Furthermore any call limitations such as an international call restriction may be programmed into the telephone as part of the function profile. When the telephone is returned, the call transactions are downloaded into the base system computer and the software program calculates the amount of rental fees required. These fees may then be charged on a credit card, which may be used to secure the rental at the outset, or paid for by any other acceptable means. If the user requires a detailed call transaction report as part of the receipt, the software can generate this from the call transaction data supplied by the telephone.

A third role, and perhaps the primary operating embodiment desired to be supported by the present invention, is the capability to operate the mobile telephone in the call cost management and billing control role. This role allows the telephone to be used in a substantially normal manner, i.e., as a standard mobile telephone. The telephone function is enhanced, however, to include a set of functions for call tracking, call monitoring, and billing as determined by the preprogrammed function profile. Preferably, the telephone is
programmed with the capability to handle an extensive directory of telephone numbers that can be directly correlated with called party names, accounts, budgets, and project numbers. The start call time and date, end call time and date, telephone number dialed or Caller ID (if enabled by the function profile and the usage in an area where Caller ID is available), actual party to which the conversation takes place, and the account, budget or project associated with this call is recorded as a transaction for each call. Any number may be dialed from the telephone’s directory, or manually dialed in the normal manner. If a telephone number is manually dialed, the telephone will automatically try and link the number to one already stored in the internal directory. If no match is found, the user is provided with the opportunity to enter new identification information as to called party and applicable account for the call cost tracking or later call billing. The start and end time and date, the dialed number or incoming flag and the call type is preferably stored for all calls regardless of the other information entered. Thus the present invention allows the calls to be completely tracked automatically from a pre-loaded directory or adds the capability for manual entry.

For situations requiring more cost control than billing, the telephone may also be loaded with a call restriction database or data collection. This option of the function profile preferably establishes a control basis defining whether the user is allowed to make international or long distance calls, the amount of personal call minutes that the user is allowed to make, and whether non-categorized calls will be billed as personal calls or whether the mobile telephone will force the user to identify from the existing telephone stored data or enter called party and
account information for all calls made and received by the mobile telephone.

Under a call cost management and billing function profile, a preferred aspect of the invention is the provision to download a sub-profile for that effectively serves to characterize the particular role established by the function profile. Call cost control for a government agency trying to control the usage of mobile telephones is an entirely different application than that of an attorney wanting to track calls in order to bill clients for the time spent on the mobile telephone. The first use might require that the telephone be deactivated until a user checks the telephone out from a central source. Thus, upon checkout, the telephone is activated for a set amount of time for this particular user. The sub-profile may be used to require that the user identify all calls, i.e., if the user makes a call that can not be correlated to an entry in a resident telephone directory data collection, the user must enter the missing information to keep the telephone active for the next call. A received call would require some additional manual entry, but could be supported by Caller ID if available. Call accounts for personal calls may be supported by the sub-profile, though potentially with effective cost or call duration limitations, to allow for some flexibility in the telephone's usage, but still allow for effective cost controls to be enforced.

This sub-profile can be flexibly specified such that, in a legal billing application for example, the sub-profile would not necessarily enforce the many controls available. Rather, the sub-profile might be designed to enable and support, through ease-of-use, the tracking of calls for billing purposes. Consequently, a potential attorney-user would be able to readily use the mobile telephone as a standard telephone, with no
enforced controls over type of dialing or whether calls are personal or not. Yet, the ability and largely automatic support for the tracking and correlating calls for client billing purposes would be immediately provided by the mobile telephone.

Thus, under the call cost management and billing function profile or other profile/role of the mobile telephone of the present invention, a sub-profile or “application profile” can preferably be programmed into the mobile telephone to establish application parameters that serve to further characterize the operation of the mobile telephone of the present invention within the role established by the function profile.

The present invention further encompasses, for a preferred embodiment of the present invention, the programming of the mobile telephone with an additional sub-profile, designated as a “user profile.” With a mobile phone programmed with function and application profiles, an additional level of profiling can be programmed to enable the mobile telephone to fit the needs, or restrict the needs, of the particular user that will operate the telephone. Here, operating parameters for the particular user are downloaded into the mobile telephone when the telephone is checked out or provided on a long-term or permanent basis. The user profile might contain the call controls and enable options for that particular user, such as further specifying the amount of personal calls that can be made or whether and when the telephone billing directory containing the numbers available in the mobile telephone data collections may be updated or extended this particular user. Preferably, the user profile can also include a user’s own personal telephone directory and set of billing accounts. This allows a relatively complete set of “likely” used data-set records to be present in the telephone. The ability to internally
record links between records to record actual uses allows the available internal telephone memory to be used with greater efficiency.

Additionally, the user profile may be used to enable a connection through the communications port of the mobile telephone to a personal digital assistant (PDA). Depending on how the options are established within a particular user profile, a PDA or other computer device could be used variously to review and appropriately revise call transaction records, provide a convenient interface to revise the user telephone directory and related information, and potentially off-load call transaction records as back-up storage or alternate transfer to the base station computer system.

The communications port and operation of the present invention can also be effectively used to accurately record categorize calls for mobile telephone modem usage. Conventional notebook computers and PDAs, for example, can be easily configured to prefix telephone numbers with DTMF encoded information. The user profile of the present invention can be used to enable the recognition of such coded information, particularly as directives of how to account for a particular call, when a computer connection is made through the mobile telephone communications port.

These three roles and their corresponding function profiles for the mobile telephone are but examples of the potential of the present invention. The present invention, however, contemplates using a mobile telephone constructed as required to embody the present invention and nominally configured with a function profile that enables no more than normal telephone operation. Any function profile configuration subsequently programmed into the mobile telephone then defines, at a minimum, the role of the telephone and, further through sub-profiles, the
various limitations and constraints to be exercised by the telephone in that role. The programming of the sub-function profiles may further incorporate data collections that can be specific to the user, the function profile determined role of the mobile telephone, or both. These data collections are available to support both automatic and manual information entry in support of the acquisition and characterization of usage information.

Accordingly, the preferred embodiment of the present invention utilizes a mobile telephone data structure that includes a mobile telephone configuration layer, which determines the operating role of the mobile telephone, a communications function layer, which controls or qualifies the nature of the operation of the mobile telephone in its selected operating role, and a user layer, which provides typically user specific data useful in helping or supplementing the association of call categories and accounts with particular calls.

As a practical and desirable consequence of the present invention, the potential manufacturer of rental or controlled usage mobile telephones can sell mobile telephones implemented in accordance with the present invention into situations requiring quite different telephone roles without needing to support specific, and different, mobile phones for each role. Similarly, the service provider who must stock mobile telephones for rental, lease, or sale for different roles need only stock mobile phones implementing the present invention to meet the fluxuating needs of their users. The programmability of function profiles thus enables mobile telephones constructed in accordance with the present invention to be viewed as a unique "generic" and cost effective means of
providing mobile telephones in a wide variety of usage roles and, further, that can be finely tailored to the user's and supplier's requirements.

The requirements for a mobile telephone to be used in an implementation of the present invention are generally shown in the block diagram of Figure 1. These requirements include:

1) the internal microprocessor that normally controls the available telephone functions must be of sufficient capability and include enough program memory to add the cost control/billing/profiling firmware of the present invention to the otherwise existing telephone control functions;

2) an appropriate part of the existing telephone program must be stored in flash or other such memory that can be reprogrammed to integrate with the added cost control/billing/profiling firmware of the present invention;

3) a sufficient amount of Electrically Erasable Programmable Read Only Memory (EEPROM) or other such memory must be available to hold descriptive data for more than about 100 call transactions and preferably from 500 to 1,000 call transactions at a time (possible alternative memory technologies would include CMOS battery backed up memory or the equivalent, but the flash and EEPROM memory is preferred);

4) a time/date clock with backup power, i.e., a battery, for keeping track of the time, date and call duration for a telephone call; and either or both

5) a peripheral port that allows the telephone to be connected to a standard RS-232 type serial, infra-red or other communications port for communications with a computer to permit the uploading of call and billing information from the telephone and downloading of profiles, programs, and other information into the telephone; and
6) a DTMF (touch-tone) transceiver or a data modem to allow a direct wireless link to be established between the mobile telephone and the computer for call descriptive data download and potentially remote telephone programming (a modem is preferable, but existing conventional mobile telephones are more likely to have a DTMF transceiver than a modem).

In addition, the mobile phone should have an adequate display for presenting information to the user, such as a two-line (plus ICON line), though preferably a 3 line (plus ICON line) liquid crystal or similar type display is preferred.

A mobile telephone that has been designed to meet the requirements of the present invention is the NSA2010 mobile telephone, manufactured by Niigata Seimitsu of Japan. Conventional mobile telephones, from vendors such as Motorola™ and Nextel™, also meet the above requirements for the mobile telephone of the present invention. A particular example is the Nextel i1000, manufactured for Nextel by Motorola.

The base station software package to which the mobile telephone communicates runs on a stationary computer such as a IBM™ compatible personal computer running any of the Microsoft™ Windows™ operating system, though preferably on Windows 95™, 98™, or NT™. This application software can be implemented as a stand-alone program that presents as a complete mobile call cost management, control and billing system on a single computer or networked group of computer systems. The software application can also be implemented as a software module that links with or is an adjunct to a pre-established software package already running on some base system computer. Such pre-established
software packages are conventionally available for adding or enabling the tracking and billing land-line telephone type calls through a computer managed PBX telephone system.

The interconnection between the mobile telephone and the base station computer can take place by directly connecting the mobile telephone to the computer through a data cable linking the telephone's peripheral port to the computers serial communications port, putting the telephone into a separate cradle in which the cradle connects to the telephone's peripheral port and also connects to the computer's serial communications port, or over the mobile telephone radio link via DTMF (Dual Tone Multiple Frequency) signals, i.e., touch-tone signals, or via a data modem located internal to the mobile telephone. The first and second cases require no additional computer hardware beyond the standard serial communications port. The third case requires a special DTMF transceiver connected between the computer's serial communication port and a standard telephone line, although a plug-in compatible card for the computer bus could also be used. The fourth case requires that the computer be connected to a standard data modem compatible with the modem chip inside of the mobile telephone.

The base station application software of the present invention includes the software modules to structure, enter data, and download the function, application and user profiles into an appropriately connected mobile telephone. This software may be differently structured based on the role that the application is intended to support, i.e., selectively includes support for configuring profiles for only selected roles that can be implemented by the mobile telephone of the present invention. Thus, a largely conventional Debit/Pre-Pay software package might be used in
support of the corresponding roles of the mobile telephone, though with the addition of the role configuration and related modules needed to program the mobile telephone of the present invention. Thus, the software application would appear to be a standard or third-party stand-alone application supporting a discrete mobile telephone role or roles.

Figure 2 shows the connection between the mobile telephone and the base station computer for direct connect information retrieval from the telephone and for programming the telephone with profiles from the computer. This connection may be made with a direct connect cable between the telephone’s peripheral port and the computer’s serial communication port or the telephone may be placed in a cradle that performs the equivalent function. The use of the cradle is to provide ease of connection for the telephone users. In a preferred embodiment of the present invention, the communication link is an RS-232 serial data link operating at 4800 baud, but this link could be established using other types of link speeds or types, including for example, infra-red and low-power, short range wireless links.

Figure 3 shows the equivalent connection made remotely via the Dual Tone Multi Frequency (DTMF or Touch-tone) signaling capabilities of the telephone. As generally discussed above, the mobile telephone of the present invention has the capability to receive as well as transmit DTMF signals. These signals are controlled by the telephone’s central microprocessor. A connection between the telephone and the remote computer may be made from the telephone by dialing the computer’s access telephone number from the mobile telephone or from the computer by dialing the mobile telephone’s number. The function profile initially downloaded to the telephone from the computer contains the
operating code for controlling the DTMF remote link. This is shown as one of the downloaded functions in Figures 5(b), 5(c), and 5(d). When a call is made to the remote computer from the telephone, the special DTMF Encode/Decode Unit shown in Figure 3 automatically answers the telephone, communicates to the computer that a telephone is attempting access and sets up a direct link between the telephone and the computer by decoding the telephone’s DTMF signals to standard ASCII computer data and encoding the computer’s ASCII data to DTMF signals for the telephone side. Once this connection is made, the telephone automatically sends its ID and any other access information required to the computer. If the computer accepts access, the link is fully established and data from the telephone may be downloaded to the computer, or the telephone’s internal data may be remotely programmed by the computer. The ID and access information is used to insure that only pre-programmed telephones from the respective computer initial telephone setup may remotely access the computer. The same type of link takes place when the computer calls the telephone. However, in this case, the telephone checks the access information and ID to prevent unauthorized users from changing the telephone’s stored information.

Figure 4 shows the equivalent communication link using a modem instead of the DTMF signaling. Here, an internal modem is included in the basic design of the telephone or an external modem may be connected via the telephone’s peripheral data port. The overall function is the same, i.e., remote information download to the computer or remote telephone programming modification by the computer. A modem will usually offer much higher data throughput rates than the DTMF signal channel.
Figure 5(a) shows the mobile telephone being programmed with a function profile. These function profiles alter the basic use of the telephone by enhancing the telephone's internal program structure. In a preferred embodiment of the present invention, the function profile loaded into the telephone includes the following program database structures and algorithms for each function profile role:

1. Debit/Pre-Pay function shown in Figure 5(b):
   a. Call Charge Database: Stores prices paid by customer for each call type (local, roaming, long distance, international) and rates for long distance and international by area or country code respectively.
   b. Emergency Number Database: Stores emergency numbers that will not be billed to the user.
   c. Pricing Algorithm: Algorithm for calculating running total of money spent on calls with comparison to pre-paid amount for regulating telephone activation and user warning messages.
   d. Call Summary Database: Stores running total of elapsed time for outgoing and incoming calls, call type (no charge, i.e., 911 type, local, roaming, long distance, international), bill code for call type (area code or country code for long distance and international calls).
   e. Area Code Exclusion Database: Stores up to 15 area codes that will be classified with a call type as local instead of long distance. This allows 800 type number dialing or local calling in which area codes must be used, but cost is charged on a local call basis. Database structure is loaded under the function profile while actual numbers are loaded under the user profile, i.e., local rental company profile.
f. Remote DTMF or Modem access program as described above.

g. Secure access information and telephone ID for access to the remote computer by the telephone or access of the telephone by the remote computer.

h. Normal telephone operation functions.

2. Mobile telephone Rental function shown in Figure 5 (c):

a. Call Transaction Database: Stores start time/date, end time/date, telephone number or incoming call flag and type of call (local, roaming, long distance, international).

b. Convenience Number Database: Stores quick dial convenience numbers for local services such as rental service, taxis, airlines, hotels, restaurants, etc. along with an alpha descriptor code for each number. Sorted alphanumerically with fast search control. Fast Search Control is defined as the user capability to enter an alpha digit or digits on the telephone keypad to quickly reach a range of alpha descriptors in the directory. Directory structure is loaded under function profile while actual directory numbers are loaded under user profile, i.e. local rental company profile.

c. Customer Limitation Flags: Stores maximum allowed daily usage in minutes, maximum allowed call minutes, maximum number of calls allowed, long distance dialing allowed flag, international dialing allowed flag, minute roundup threshold (number of seconds over a minute that will cause the call duration to be rounded to the next minute). Flag and Limit structure is loaded under the function profile while actual flags and limits are loaded under a user profile, i.e. local rental company profile.
d. No Call Charge Database: A list of numbers for which no charges will be applied. These are usually emergency numbers such as 911, the rental service’s telephone number or the remote computer access number.

e. Area Code Exclusion Database: Stores up to 15 area codes that will be classified with a call type as local instead of long distance. This allows 800 type number dialing or local calling in which area codes must be used, but cost is charged on a local call basis. Database structure is loaded under the function profile while actual numbers are loaded under the user profile, i.e. local rental company profile.

f. Remote DTMF or Modem access program as described above.

g. Secure access information and telephone ID for access to the remote computer by the telephone or access of the telephone by the remote computer.

h. Normal telephone operation functions.

3. Call Cost Management and Billing function shown in Figure 5(d):

a. Call Transaction Database: Stores start time/date, end time/date, telephone number or incoming call flag, type of call (local, roaming, long distance, international), called party name alpha descriptor and billing code for each call on the system.

b. Phone Directory Database: Stores quick dial numbers which include telephone number, alpha descriptor for the number, alpha descriptor for default billing code and billing code. Sorted alphanumerically with fast search control. Fast Search Control is defined
as the user capability to enter an alpha digit or digits on the telephone keypad to quickly reach a range of alpha descriptors in the directory. Directory structure is loaded under function profile while actual directory numbers are loaded under a user profile, i.e. the person checking out the telephone.

c. Billing Code Database: Stores billing code alpha descriptors and billing codes. This database structure is loaded under the function profile, but the actual data is loaded under the application and user profiles.

d. Emergency Number Database: Emergency numbers that may be dialed in spite of the user going over exceeded telephone usage limits programmed into the telephone.

e. Called Party and Billing Allocation Algorithm: Dialing from the telephone directory will automatically link a call transaction to the alpha descriptor and the default billing code associated with this number in the directory. Manual dialing of any telephone number will search the database to try to automatically link the dialed number with a telephone directory listing in order to add the alpha descriptor and billing code to the call transaction. Incoming calls and manually dialed calls not in the telephone directory allow an alpha descriptor to be entered by manually scanning the telephone directory (for cases in which the name and billing code is in the telephone directory, but the party was reached at a different number) or manually by entering from the keypad. The billing code may be entered for these type of calls by selecting an alpha descriptor or billing code from the Billing Code Database.

f. User Database Operation Program: The control program that supervises that in effect executes the function profile, and
manages user interface when the mobile telephone is operated in the Call Management mode.

g. User & Limit Flags: Stores maximum allowed daily usage in minutes, maximum allowed call minutes, maximum number of calls allowed, long distance dialing allowed flag, international dialing allowed flag, minute roundup threshold (number of seconds over a minute that will cause the call duration to be rounded to the next minute), maximum personal call usage in minutes, flag for billing unclassified calls as personal, flag forcing entry of billing code and called party link to each call before next call is allowed (if this assignment can be done automatically by the system with the telephone directory link). Flag and Limit structure is loaded under the function profile while actual flags and limits are loaded under either the application or user profile.

h. Area Code Exclusion Database: Stores up to 15 area codes that will be classified with a call type as local instead of long distance. This allows 800 type number dialing or local calling in which area codes must be used, but cost is charged on a local call basis. Database structure is loaded under the function profile while actual numbers are loaded under the user profile.

i. Remote DTMF or Modem access program as described above.

j. Secure access information and telephone ID for access to the remote computer by the telephone or access of the telephone by the remote computer.

k. Normal telephone operation functions.

l. Restricted telephone operation functions: Restricts telephone functions and their operation under the downloaded user
profile, i.e., no international dialing or billing code modifications allowed, for example. Supports and enforces the conditional constraints under which the user can add to or edit the telephone directory database. Nominally provides support for the user to select billing codes and billing alpha descriptors from the billing code database for call transaction allocation and prevents the user from changing or editing this database.

For a preferred embodiment of the present invention, two application profiles will be described in connection with the Call Management function profile defined role. The first, as shown in Figure 6(a), is a Call Tracking and Control application. Here, the Call Management function profile is used to track all calls made from or received by a particular mobile telephone with the purpose of accounting for the calls that are made and restricting the usage of the telephone to limits set, for example, globally by a function profile or specifically in an accompanying user profile. An example of this type of application might be usage of the telephone by a government or law enforcement person. Here, the primary requirement is to provide mobile telephone usage to the employee, but at the same time be able to track all of the calls made so that they can be allocated to the correct budget category for the employee's department. At the same time, personal limits are enforced to prevent problems with excessive personal calls or international calls that could easily affect individual budgets adversely. In conjunction with the Call management function profile data structures, the following additional application profile data structures are programmed into the mobile telephone of the present invention:

1. The user can be restricted to dialing the telephone from the telephone directory Database. The only exception allowed is billing to the
default category. The default category is the Personal Category, the Unknown Call Category or the Non-billed Category whichever is selected as default under this particular user profile. These separate categories can be tracked by the software for later billing or cost allocation to the correct account number in the software database.

2. All calls made on the telephone are linked to the information in the telephone directory. The user dials a telephone number or selects an alpha designator name in the directory which will enable an auto-dial of the respective number. When this is done, the system automatically links the Directory information of the alpha designator (linked to the Account number in the computer software), the number dialed and the Billing Category to the call transaction data for this call. The rest of the call transaction data includes the time/date of the call, the duration of the call and the type of call, i.e., roaming, long distance, international, or other.

3. All incoming calls in this application mode force the user to link the call to a called party or account. This may be selected from the telephone directory or entered manually if the information is not in the telephone directory. If it is entered manually or if the information is not entered in, the call is automatically billed to the default account, i.e., Personal, Unknown or Non-billed.

4. Limits can be set on the total number of minutes that the telephone can be used, the total time the telephone can be checked out, the total amount of personal time allotted, the use of long distance or international dialing, and others. In general, this sort of application lends itself to apply call transaction information to budget categories, project
categories, etc. and at the same time control telephone usage so that no overruns appear later as large problems.

A second preferred type of application profile is shown in Figure 6(b). Here the calls are tracked for actual client billing purposes such as with legal applications. Attorneys normally use automatic telephone billing programs on their land-line based telephones to track and bill their clients for telephone calls made on their behalf. This tracking, and thus billing, can not be done on a cellular telephone at this time without trying to decipher the required information from the month-end cellular bill. More often than not this bill does not contain the information required to bill the client, i.e., it is missing such information as the actual party called at a particular number and any reference to what type of call it was and how it should be billed. For this reason, many law firms do not bill clients for cellular placed calls because they have no backup for what the call was about and what type of billing to charge.

The invention changes fundamental aspects of this scenario. When the application profile for Call Tracking and Billing is loaded into the mobile telephone of the present invention, all of the necessary information to bill a call to a client account is available for every call. This includes not only the number dialed and the time/date and duration of the call, but the actual called party to be billed and the billing category under which the billing should take place, i.e., for an attorney, was the call direct legal work, a call on a client's behalf, or other billable use of the telephone.

In combination with the Call Management Software package, all of these calls can actually be billed to a particular account with automatically calculated charges and documented backup. Furthermore, all non-
billable calls such as personal calls or non-charge calls can be tracked and allocated to the correct internal budgets within the law firm.

The application profiles discussed above are only two of many that can be generated by the combination of the mobile telephone's downloaded software and the Call Management Software running on the base station computer.

Another preferred aspect of the present invention is the capability of customizing the mobile telephone for a specific user. The Call Management software preferably supports for the creation of individual user profiles that can then be downloaded into the mobile telephone of the present invention and used to further qualify the executed operation of the telephone based on the function and application profiles. A preferred user profile is outlined in Figure 7 and, in general, defines constraints and adds additional collection data to the function and application profiles. A user profile can be programmed with the following information:

1. User Telephone Directory Database: Normally a complete telephone directory for a large company or project would be much too large to store within the mobile telephone's limited memory. The user profile may allocate information from the telephone directory that is utilized by that specific user to the user profile that is downloaded into the telephone. Thus, a limited version of the telephone directory, but one containing the information required by this user, is stored in the telephone.

2. User Billing Code Database: This is the entire billing code category database set up within the Call Management software. This allows the user to select billing categories for each telephone call.
transaction in which the billing is not automatically selected by using the telephone directory for dialing.

3. Default Billing Preference: This is the default billing for all calls that the internal telephone software can not classify. It is set within the Call Management software on the computer for this user. Possible defaults are Unknown, Personal and No- Billing.

4. Forced or User Selectable Billing: This allows or disallows the user from selecting how each call is to be billed. If selection is not allowed, the billing is set by the internal telephone directory setting and cannot be changed by the user.

5. Call Restrictions: Primary user restrictions at this time are long distance dialing or international dialing. If these flags are set, the user is not allowed to dial the respective type of call. Other possible restrictions may be added.

6. Amount of Personal Time Allowed: This is number of minutes of personal calls that a user is allowed on a daily basis. If the amount is exceeded, the user is only allowed to dial from the telephone directory with preset billing allocation or to dial from the emergency number list. Incoming calls require manual billing allocation by the user if Caller ID is not activated. If Caller ID is activated the telephone will select the billing allocation from the telephone directory if possible, otherwise manual entry is forced. A maximum value entry of 65536 is preferably interpreted as allowing unlimited time. A zero entry does not allow the user to make personal calls outside of the available entries in the Telephone Directory or the Emergency Number List.

7. Phone Activation Period: This is the number of days that the telephone will be active. If this is exceeded, the user must recheck out the
telephone to re-activate it or use the emergency number listing to connect to the remote computer for re-activation (if this has been set up). A maximum value entry of 65536 is preferably interpreted as allowing unlimited time.

8. Maximum Allowed Call Minutes: This is the maximum number of minutes of call time that the user is allowed for any telephone checkout period. A maximum value entry of 65536 is preferably interpreted as allowing unlimited usage.

9. Personal Billing Code: This is the billing allocation for all personal calls for this user.

These user profiles are set up in the Call Management software on the base station computer. When a telephone is checked out to a particular user, the respective user profile is loaded into the telephone. Alternately, various levels of profiles can be established earlier with just a selection of a particular profile being performed at the time the mobile telephone is checked out to a particular user.

In a preferred embodiment of the present invention, a user may dial a number on the mobile telephone in several ways. These include:

1. Enter the two digit code (00-99) for the telephone directory listing;
2. Manually dial (normal telephone type dialing);
3. Scroll to the desired number or name in the telephone directory for number selection;
4. Dial from the telephone directory, but edit the call information for this call transaction.
The discussion below of dialing techniques and data entry on the mobile telephone assumes that the telephone being used has a four line display. In this case the display is set up as shown in Figure 8(a) when dialing. Other telephones may be used with the software, but the display will be appropriately modified in order to present the same or similar information on less than 4 display lines.

Figure 8(b) shows the display on the telephone when a user enters a two digit code for dialing. As soon as the two digit code is entered the display indicates the telephone directory entry that was selected. The user pushes the SEND key on the telephone to dial the number.

Figure 8(c) shows the user dialing the telephone in a normal manner with no help from the telephone directory System. Here the user just manually enters a telephone number and pushes the SEND key to dial. The entered number is displayed as the numbers are selected. The telephone will automatically determine if the entered number is in its telephone directory. If it is, the telephone directory information as to Called Party and Billing Code will be added to the call transaction report for this call. If the number is not in the telephone directory, the call transaction will use the default listing for a non-classified call, i.e. Personal, Unknown or Non-Billed.

Figure 8(d) shows the display while the user is dialing from the telephone directory. Telephone directory dialing is activated by pushing the MEM key or other equivalent key on the telephone (this key may change depending upon the telephone). Telephone directory selection may be done by scrolling from the first directory entry using the scroll forward (V) or backward (A) keys (actual keys may differ depending upon the telephone). Alternatively any alpha/numeric key on the telephone’s
keypad may be pushed to start the telephone directory scrolling at that alphabetic listing in the directory. When a desired listing is found, the SEND key is pushed to dial the number.

The basic telephone display, as shown in Figure 8(a), illustrates what a user preferably sees when scrolling through the telephone directory to select a number to dial. As shown, the Billing Code Designator displays as a 9 character name for a particular Billing Code. The corresponding numeric Billing Code might be shown by, for example, pushing the MEM or other designated key on the mobile telephone.

A user may also dial the telephone and manually enter/select the Called Party, Number to Dial and Billing Code information. This is shown in Figure 8(e). The only limitation to this data entry is that the user must select the Billing Code from the Billing Code Category Listings stored in the telephone under this user's profile and this is only allowed if the Bill Flag for this user is set under the profile. If the flag is not set, the billing information will be set to the default for this user, i.e. Personal, Unknown or Non-Billed.

An incoming call generally cannot be automatically classified unless Caller ID is activated for the telephone. This may not be available on some mobile telephone systems or may not be activated. If Caller ID is active, the information will be used to link a call to the telephone directory or to at least add the Calling Party name to the Call Transaction Data. In the case that Caller ID is not available, the user may enter the required information using the process shown in Figure 8(f). Again, the user may only select the Billing Code for this call if the correct flag is set in their profile. Otherwise the default billing will be applied. The user may decide not to enter any call data by just pushing the END key for a
second time. This keeps the operation of the telephone as close to normal as possible for users that want to bypass the detailed information call transaction process for incoming calls. However, any incoming call that can not be classified will be categorized under the default category.

Some users may be able to add new telephone directory listings directly on the telephone via the keypad. This is allowed only if the Add Flag is set within the user profile. Figure 8(g) shows the preferred process for adding an entry to the telephone directory from the telephone's keypad if it is allowed. Again, Billing Code data must be selected from the available codes in the telephone.

Any new information entered into the telephone manually by the user will automatically be recognized by the Call Management software on the base station computer when the call transaction data is downloaded during telephone check-in. New data is preferably flagged by the software, providing the base station system operator with the capability of adding the data to the main system on a permanent basis, or just for the particular call transaction.

The telephone management application software running on the base system computer may operate in different modes depending on the particular capabilities of a particular mobile telephone constructed in accordance with the present invention. In particular, where memory space in the telephone is limited, the management application also preferably prepares a package of executable routines, as needed to support an accompanying function profile, for download and programming into the mobile telephone. Where memory space is not a constraint, these executable routines, including those needed to support a variety of different function profiles, can be initially programmed into the mobile
telephone. In the former circumstance, the mobile telephone is essentially "blank" until both the function profile and corresponding executable routines are loaded. In this latter circumstance, only a new function profile is needed to establish the role of the loaded, yet still effectively "blank" telephone.

Thus, as generally illustrated in Figure 9, the present invention permits the management application to be presented as either two separate application packages or as a single application that combines the function of the two application packages. The first application package is responsible for preparing and linking, as appropriate, the various combinations of executable routines that are to be programmed into a mobile telephone of the present invention. The second application package is responsible for constructing a function profile that is supportable by a particular blank mobile telephone. That is, the firmware needed to establish a role as, for example, a pre-paid telephone, rental telephone, or call management controlled telephone could be downloaded into the mobile phone at, for example, a telephone distribution facility or telephone manufacturing site to establish, before being shipped to a customer or service provider, the scope of available roles and features that may be subsequently configured into the mobile telephone's operation. The user or service provider, depending on the nature of the telephone's role, can then subsequently execute the second application package to prepare function profiles, within the scope of the executable routines available, and create application and user profiles for programming into the mobile telephone. Of course, the available scope of executable routines can be limited by software flags, set in connection with the factory configuration of particular mobile telephones for
particular users or service providers, thus making a blank mobile telephone appear to lack some set of the executable routines.

In the alternate circumstance where a single application program incorporates both responsibilities, the user or service provider who operates the single application performs both the loading of executable routines, to the extent required, and the configuration of a corresponding function profile. The additional configuration of application and user profiles is also supported by the single application.

In a preferred embodiment of the present invention, the management software application executed by the base station computer can also implement or interface with billing and accounting software in conjunction with the Call Management control role. The transaction data collected by the mobile telephone and collected and processed by the management software allows not only detailed paper reports to be prepared, but also detailed reporting data to be further utilized in conventional billing and const management systems. A general block diagram of this software process is shown in Figure 10. Thus, for a Call Management Service that provides mobile telephones for short or long-term use, for example, the service operator, has the ability through the implementation and configuration of the of the call management and control role of the mobile telephones and the base station software application to operate as follows:

1. Establish data collections, typically as part of the initial and ongoing management of the service, that incorporate information for characterizing application and user profiles, including, for example, an electronic master telephone directory, chart of billing accounts, and current category and project codes, as well as mobile telephone call rates,
long distance and international access and call charge codes, and sets of emergency and service provider supported telephone numbers that can be used in geographically different areas or territories;

2. Prepare a mobile telephone for check-out to a specific user by programming the telephone with application and user profiles, including a telephone directory and defined Billing Categories. The telephone is then activated and released to the user. The user's check-out information is added to the check-in/check-out database maintained by the base station application;

3. Monitor, through the base station application, modem, serial or other communications port for any calls from a mobile telephone implementing the present invention. Upon making such a connection and establishing a remote data transfer session, the application will interrogate the calling mobile telephone for identification and access information. In a preferred embodiment of the present invention, once such a session is established, any of the following actions may be taken:

   a. Download call transactions and telephone directory additions from the telephone and clear the telephone internal call transaction database (the transaction data may be stored for subsequent review when the telephone is checked-in or processed immediately for short cycle billing and accounting;

   b. Reset the call timer or time/date functions on the telephone to extend usage in the case where user is approaching or has exceeded profile determined limits and is requesting an extension;

   c. Reset the charge counter in the case where the user wants and authorizes the purchase of more time on mobile telephone operating in a pre-pay or debit role;
d. Update the telephone's execution routine programming or profiles in case of problems; and

e. Send any messages to the user to be displayed on the telephone; and

3. Receive a mobile telephone for check-in from a user. The call transaction information is downloaded from the mobile telephone and processed by the base station application. As part of this processing, the call transaction information is displayed, checked, and potentially edited by the operator. An electronic report of the transactions may be forwarded to a financial accounting system. A transaction report might be presented to the user for checking as well. Finally, the check-in relevant information, as well perhaps as the call transaction information, is then added to the database managed by the base station application.

The editing of the transaction data, though affecting only a very small fraction of the total transaction data, is especially useful for handling Unknown labeled calls. At check-in, the service operator may want or require the entering of additional information to minimize Unknowns calls for general accounting purposes. Also, call transactions that contain new data, potentially as added by the user while using the mobile telephone, can, at this time, be integrated into the base station database.

In a preferred embodiment of the present invention, transaction data to edit and report generation can be selected under the following categories:

a. All Call Data
b. All Personal Calls
c. Personal Calls Selected by a Particular User
d. Unknown Calls

f. Non-billed Calls

g. Non-billed Calls Selected by a Particular User

h. Calls by a Particular Billing Account

i. Calls by a Particular Billing Category

j. telephone Check-out Data & telephone Status

k. telephone Check-In Data and telephone Status

l. Data that has been archived

Regarding the preparation of reports by the present invention, an important aspect is that the reports are based on data collected and thereby reflecting the real-time and actual use of the mobile telephone of the present invention.

Thus, in summary, the present invention is a combination of hardware and software that combines and interacts to define and support, when and as needed, the operation of mobile telephones in multiple different roles. The present invention further enables the capture of real-time transaction data, additionally detailed through links to and use of collections of information stored internally by the mobile phone. These abilities are particularly advantageous in supporting a call management and control role that notably enables short-cycle accounting actual-cost billing for the use of the mobile telephone. The ability to pre-establish constraints and enforce actual limits on the usage of the mobile telephone of the present invention is also notably advantageous.

While the present invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and
details may be made therein without departing from scope and nature of
the present invention as defined by the appended claims.
Claims

1. A communications and management system comprising:
   a) a mobile telephone including a processor and a memory
   supporting the storage and execution of a control program having first
   and second control program functions, the storage of a predetermined
   set of data records, and space for the storage of a plurality of operations
   data records, execution of said first control program function by said
   processor implementing a predetermined set of immediate operational
   functions and execution of said second control program function by said
   processor implementing a predetermined set of supervisory functions,
   wherein a first supervisory function includes selectively associating the
   execution of a predetermined first immediate operational function with a
   first predetermined data record and storing a corresponding first
   operations data record in said memory, said mobile telephone further
   including a first data communications port; and
   b) a host computer system including a processor and a
   memory supporting the storage of predetermined information defining
   a plurality of operating modes of said mobile telephone and the storage
   and execution of an application program operative over said
   predetermined information to select and configure a device operational
   management profile, said host computer further including a second data
   communications port coupleable to said first data communications port
   to enable transfer of said device operation management profile to said
   mobile telephone and to receive said operations data from said mobile
   telephone.
2. The communications management system of claim 1 wherein execution of said application further provides for the processing of said operations data to provide a detailed report of the recorded use of said mobile telephone, said host computer system including mobile telephone rate data for reference in the processing of said operations data to provide corresponding detailed call cost information as part of said detailed report.

3. The communications management system of claim 2 wherein said device operational management profile is determinative of an overall mode of operation of said mobile telephone, which said mode of operation can be any of pre-paid/debit operation, rental operation, and real-time call cost management, control, and billing.

4. A mobile telephone comprising:
   a) a mobile handset including electronics implementing a wireless communications terminal; and
      a) an embedded micro-controller system including memory and a firmware program, wherein said firmware program provides for the storage of a plurality of function profiles, wherein each of said function profiles defines a respective predetermined set of enabled functions of a set of enableable functions implementable by the execution of said firmware program in control of said electronics, and wherein said firmware program further supports programmable selection of a predetermined one of said function profiles, whereby said predetermined one of said function profiles serves to define the function of said mobile handset.
5. The mobile telephone of claim 4 wherein set of enableable
functions includes at least two call management functions selected from
a set of call management functions including any of:
   a) a call duration management system function;
   b) a called party management system function;
   c) a call accounting management system function; and
   d) a call type management system function.

6. The mobile telephone of claim 4 wherein said set of call
management functions includes:
   a) a call duration management system function;
   b) a called party management system function;
   c) a call accounting management system function; and
   d) a call type management system function.

7. The mobile telephone of claim 5 wherein said embedded
micro-controller system includes a data port capable of exchanging
operational data and programming information with a host computer
system, wherein said programming information is received to
programmatically select said predetermined one of said function profiles,
and wherein said embedded micro-controller system produces said
operational data through the execution of said firmware program subject
to said predetermined one of said function profiles.

8. The mobile telephone of claim 7 wherein said firmware
program further provides for storage of a predetermined application
profile and wherein said embedded micro-controller system executes said firmware program in implementation of a predetermined call management function subject to said predetermined application profile.

9. The mobile telephone of claim 8 wherein said predetermined application profile includes customization data usable by said embedded micro-controller to define an executable implementation of said predetermined call management function.

10. The mobile telephone of claim 9 wherein said firmware program further provides for storage of a predetermined user profile, wherein said embedded micro-controller system executes said firmware program in implementation of said predetermined one of said function profiles and said predetermined call management function subject to said predetermined user profile, and wherein said predetermined user profile includes information that is associated with a predetermined user of said mobile telephone.

11. The mobile telephone of claim 10 wherein said predetermined user profile includes at least two user data collections selected from a set of user data collections including any of:
   a) a billable telephone number collection;
   b) a billing account collection;
   c) a billing category collection; and
   d) an unbillable telephone number collection;
12 The mobile telephone of claim 11 wherein said embedded micro-controller system produces said operational data through the execution of said firmware program by correlation of called telephone numbers with user data obtained from said user data collections.

13. A mobile telephone management system comprising:
   a) a host computer system including a data transceiver and a predetermined application program executable by said host computer system; and
   b) a mobile telephone including a micro-controller, memory, and a control program executable by said micro-controller, wherein said control program includes a plurality of executable call management routines that can generate and store data descriptive of the operation of said mobile telephone within said memory, and wherein said micro-controller is coupleable to said data transceiver for the exchange of said descriptive data and telephone configuration data, wherein said micro-controller is responsive to said telephone configuration data to select a predetermined one of said executable call management routines for execution by said micro-controller to provide said descriptive data.

14 The mobile telephone management system of claim 13 wherein said host computer system provides said telephone configuration data to said mobile telephone to selectively enable a set of two or more of said executable call management routines for execution by said micro-controller.
15. The mobile telephone management system of claim 14 wherein execution of said executable call management routines is qualified by predetermined call management configuration data and wherein said telephone configuration data includes said predetermined call management configuration data, whereby said predetermined call management configuration data determines at least in part the content of said descriptive data.

16. The mobile telephone management system of claim 15 wherein said telephone configuration data includes a predetermined collection of data and wherein said micro-controller accesses said predetermined collection of data subject to the execution of said executable call management routines, whereby the content of said descriptive data is determined, at least in part, on the content of said predetermined collection of data.

17. The mobile telephone management system of claim 16 wherein said predetermined collection of data includes a telephone number directory having a first plurality of records and billing reference directory having a second plurality of records and wherein said descriptive data includes reference links relating respective records of said first and second pluralities of records.

18. The mobile telephone management system of claim 17 wherein said second plurality of records includes first sub-records descriptive of billing accounts and second sub-records of billing categories
and wherein said descriptive data includes reference links relating 
respective sub-records of said second plurality of records.

19. A mobile telephone management system comprising:
   a) a mobile telephone including an embedded micro-
controller system and an embedded control program that is executable to
   implement predetermined functions of said mobile telephone and to
   produce predetermined usage data, said embedded micro-controller
   system being re-programmable with predetermined configuration data
   that controls modifications of the implementation of said predetermined
   functions of said mobile telephone; and
   b) a host computer system coupleable to said mobile
   telephone and including an application program that is executable to
   selectively prepare and provide said predetermined configuration data to
   be re-programmed into said mobile telephone, said application program
   being further executable to receive and process said predetermined usage
   data to provide a predetermined usage report.

20. The mobile telephone management system of claim 19
   wherein said predetermined configuration data controls modifications of
   the production of said predetermined usage data and wherein said
   application program processes said predetermined usage data and
   provides said predetermined usage report subject to said predetermined
   configuration data.

21. The mobile telephone management system of claim 20
   wherein execution of said application program selectively provides said
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predetermined configuration data so as to enable the implementation of
a plurality of said predetermined functions of said mobile telephone and
wherein said predetermined functions of said mobile telephone include
recording of the time, date, and duration of a telephone call, recording
of telephone number called and the called party, and recording of the
billing account and billing category associated with the called party,
whereby said predetermined usage data may be processed to provide
telephone usage cost allocation, budgeting and billing data.

22. The mobile telephone management system of claim 21
wherein said predetermined configuration data is prepared for a
predetermined user of said mobile telephone by inclusion of a
predetermined collection of information corresponding to said
predetermined user and wherein execution of said embedded control
program provides for the selective accessing of said predetermined
collection of information to relate a called telephone number with any of
a called party, a billing account, and a billing category as provided as
part of said predetermined collection of information.

23. The mobile telephone management system of claim 22
wherein said predetermined configuration data includes control data and
wherein execution of said predetermined control program, subject to said
control data, imposes limitations on available use of said predetermined
functions of said mobile telephone.

24. The mobile telephone management system of claim 23
wherein said predetermined collection of information is provided as a
plurality of records and wherein the limitations on the available use of
said predetermined functions are defined by said control data with respect
to sets of one or more of said records, whereby different limitations may
be imposed for different called telephone numbers, called parties, and
call billing accounts.

25. The mobile telephone management system of claim 24
wherein said predetermined collection of information includes an area
code exclusion database and wherein the limitations on the available use
of said predetermined functions are defined by said control data with
respect to said area code exclusion database in connection with a called
telephone number.

26. The mobile telephone management system of claim 25
wherein said predetermined collection of information includes a called
number inclusion database and wherein the limitations on the available
use of said predetermined functions are redefined by said control data
with respect to said called number inclusion database in connection with
a called telephone number.

27. The mobile telephone management system of claim 26
wherein said host computer system includes an interface enabling a
remote coupling of said mobile telephone with said host computer system
and wherein said host computer system is responsive to predetermined
command sequences for selectively preparing and providing said
configuration data to said mobile telephone and receiving said
predetermined usage data from said mobile telephone.
28. The mobile telephone management system of claim 27 wherein said predetermined configuration data includes user related identification information for identification of any of said mobile telephone, said host computer system, a payment source for calls made using said mobile telephone, and a payment authorization code.

29. The mobile telephone management system of claim 28 wherein said embedded micro-controller system is responsive to predetermined data entry sequences and wherein execution of said embedded control program provides for the decoding of said data entry sequences to identify relative to said collection of information for calls received by said mobile telephone any of the calling party, the calling telephone number, the billing account, and the billing category.
Figure 1: Basic Mobile Phone Equipped for Running External Applications

Figure 2: Cell Phone / Computer Direct Communications Link
Figure 3: Remote Phone/Computer Link Using DTMF Signals

Figure 4: Remote Phone/Computer Link Using Modem Signals

Figure 5(a): Function Profile Software Download
**Figure 5(b): Function Profile for Pre-Paid/Debit Phone Operation**

- PRE-PAID/DEBIT FUNCTION PROFILE
  1. Call Charge Database
  2. Emergency Number DB
  3. Pricing Algorithm
  4. Call Summary Database
  5. Area Code Exclusion Database
  6. Remote DTMF access
  7. Secure Access Keys
  8. Normal Phone Operation

**Figure 5(c): Function Profile for Cell Phone Rental Operation**

- CELL PHONE RENTAL FUNCTION PROFILE
  1. Call Transaction DB
  2. Convenience Number DB
  3. Customer Limitation Flags
  4. No Call Charge DB
  5. Area Code Exclusion Database
  6. Remote DTMF access
  7. Secure Access Keys
  8. Normal Phone Operation

**Figure 5(d): Function Profile for Cellular Call Management Operation**

- CALL MANAGEMENT FUNCTION PROFILE
  1. Call Transaction DB
  2. Phone Directory DB
  3. Billing Code Database
  4. Emergency Number DB
  5. Called Party & Billing Allocation Program
  6. User DB Operation Program
  7. User & Limit Flags
  8. Area Code Exclusion Database
  9. Remote DTMF access
  10. Secure Access Keys
  11. Normal Phone Operation
  12. Restricted Phone Operation
APPLICATION PROFILE: CALL TRACKING & CONTROL
1. Utilizes Call Management Function Profile
2. Restricts Calls to Phone Directory DB unless Billed to Default Category such as Personal
3. All calls linked to Phone Directory DB to track Number Dialed, Called Party, Billing Category, Time/Date & Duration of Call, Type of Call
4. Incoming Calls Placed in Default (Personal) Category – Calling Party Name Entry Allowed.
5. All Calls Not in Phone Directory DB set as Default (Personal)
6. Limits set on Personal Call and Total Call Usage
7. User Restriction Flags

Figure 6(a): Application Profile for Call Tracking & Cost Control

APPLICATION PROFILE: CALL TRACKING & BILLING
1. Utilizes Call Management Function Profile
2. Calls can be made manually (normal cell phone operation) or Auto dialed from Phone Directory DB
3. All calls made from Phone Directory DB track Number Dialed, Called Party, Billing Category, Time/Date & Duration of Call, Type of Call
4. Manual calls track Number Dialed, Time/Date & Duration of call, Type of call – allow user entry of other call information such as Called Party and Billing Code Selection
5. Incoming Calls Placed in Default (Personal) Category – User allowed to assign Called Party Name & Billing Code (from DB)
6. Can Force Billing Code Allocation or allow User option
7. Both Billing Account & Billing Sub-Category can be tracked

Figure 6(b): Application Profile for Call Tracking & Billing
CALL MANAGEMENT: USER PROFILE
1. Utilizes Call Management Function
   Profile & Application Profile
2. User Phone Directory DB
3. User Billing Code DB
4. Default Billing Preference:
   - Unknown
   - Personal
   - No-Billing
5. Forced or User Selectable Billing
6. Call Restrictions Such As:
   - Long Distance Dialing
   - International Dialing
7. Amount of Personal Time Allowed
8. Phone Activation Period
9. Maximum Allowed Call Minutes
10. Personal Billing Code Number

Figure 7: Call Management User Profile

LINE 1 ———> Phone ICONS
LINE 2 ———> Name Designator
LINE 3 ———> Number Dialed
LINE 4 ———> Billing Designator

Push MEM to switch between Billing Designator and Billing Code

Figure 8(a): Mobile Phone Display During Phone Directory Scroll

Enter 2-Digit Call Code (00-99) ———> SND

ICONS
Name Descriptor
Phone Number
Billing Descriptor

Figure 8(b): Dialing Using 2-Digit Call Code
User Enters Phone Number to be Dialed → SND

Figure 8(c): Dialing Using Normal Phone Number Entry

MEM → [▲▼] → SND

ICONS
Name Descriptor
Phone Number
Billing Descriptor

Place call associating this Name, Number and Billing to this call

Figure 8(d): Dialing Using Phone Directory Selection
MEM → ▲ ▼ → FUNC

ICONS
Name Descriptor
Phone Number
Billing Descriptor

Scroll through
Directory

ICONS
ENTER NAME

↑

MEM

ICONS
ENTER NUM

↑

MEM

ICONS
SELECT BC
Billing Descriptor
Billing Code

↑

MEM

ICONS
Name Descriptor
Phone Number
Billing Descriptor

↑

SND

CLR = Delete Char.
& Shift right
▼ = Shift left

Use alpha keys for
entry

Note: Pushing END at any time will
cancel this mode and
return the phone to
the IDLE state.

Scroll through
Billing codes.
Select by pushing
▲▼ keys –
Only allowed if
Bill Flag Set

Place call
associating this
Name Phone
Number & Billing
Code to this call

Figure 8(e): Dialing Using Manual Data Entry for Call
Call Ended by pushing END key on phone. At this time the Default selection display appears:

<table>
<thead>
<tr>
<th>ICONS</th>
<th>END</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default Selection i.e. Personal Call</td>
<td>Default Billing is associated with this incoming call</td>
</tr>
</tbody>
</table>

MEM → ▲ ▼ → FUNC

<table>
<thead>
<tr>
<th>ICONS</th>
<th>ENTER NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name Descriptor</td>
<td>Phone Number</td>
</tr>
<tr>
<td>Billing Descriptor</td>
<td></td>
</tr>
</tbody>
</table>

Scroll through Directory

END

MEM

<table>
<thead>
<tr>
<th>ICONS</th>
<th>ENTER NUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Directory entry is Selected and associated with this call</td>
<td></td>
</tr>
</tbody>
</table>

Note: If Caller ID Activated, then User not allowed to change Number

MEM

<table>
<thead>
<tr>
<th>ICONS</th>
<th>SELECT BC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Billing Descriptor</td>
<td></td>
</tr>
<tr>
<td>Billing Code</td>
<td></td>
</tr>
</tbody>
</table>

MEM

<table>
<thead>
<tr>
<th>ICONS</th>
<th>END</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name Descriptor</td>
<td>Phone Number</td>
</tr>
<tr>
<td>Billing Descriptor</td>
<td></td>
</tr>
</tbody>
</table>

New Information is associated with this call

Figure 8(f): Incoming Call Classification
Figure 8(g): Adding to the Phone Directory
Figure 9: Creating & Downloading the Function Profile
Figure 10: Call Management Software Flowchart