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(54) **SYSTEM, APPARATUS AND METHOD FOR ENERGY CONTROL AND MANAGEMENT**

(57) The present invention presents a system, apparatus and method that allow to know in detail the energy consumption/generation, almost in real time, of the different supplies in a manner configurable for each user, enabling for example, to schedule tasks at different times according to the energy they consume, to detect machines with excess consumption/generation, calculate the optimal power that the facility requires, etc. An alert system may also be activated to warn the user when the consumption/generation exceeds certain previously established thresholds.

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Description

TECHNICAL FIELD OF THE INVENTION

[0001] The present invention relates to the field of energy management and more specifically, to a system and method for the control and management of electrical energy consumption and/or generation, enabling power consumption (or its generation) to be optimised.

BACKGROUND OF THE INVENTION

[0002] There are an increasing number of appliances basic for everyday life and industrial machinery that use electrical energy for their operation, meaning that electrical energy consumption has increased significantly in recent years. The efficient control and management of such consumption in homes, shops, offices, etc. and, especially, in industrial facilities is, therefore, fundamental to avoid wasting this resource and thus ensure the responsible consumption of this energy resource, which is not unlimited.

[0003] For a more effective use of this limited energy resource and to reduce its consumption, most electric companies offer different power prices depending on various factors such as time zone (the price may even vary on an hourly basis), season, hired power, etc., which means it is important for the consumption of a given facility to be rationalised and adapted, as far as possible, to these different rates. In addition, the increase in the cost of electricity in recent years makes the optimisation of energy consumption even more important.

[0004] The rationalisation of this consumption represents a true challenge since there are no tools that simply and reliable enable this rationalisation to be implemented. I.e., the owner of a facility can see that energy costs are high but has no means of knowing how to reduce that cost, or, in other words, there are no tools allowing the owner to know in detail, control and optimise energy consumption.

[0005] Although there are some partial solutions for measuring the energy consumption of facilities, there are no efficient solutions that enable the detailed, real and continuous control and management of energy consumption at a specific facility or set of facilities, such as the one proposed in this invention.

SUMMARY OF THE INVENTION

[0006] The aim of this invention is to develop a system, apparatus and method for the control and management of energy consumption/generation, and more specifically electrical energy (although it can be applied to any other type of energy). This invention discloses in detail the consumption (or generation, if applicable), almost in real time, of the different supplies, enabling for example, schedule tasks at different times according to the energy they consume, detect machines with excess consumption, calculate the optimal power that the facility requires, etc. An alert system can also be activated to warn the user when the consumption exceeds certain previously established thresholds.

[0007] In a first aspect, the present invention proposes a system for energy control and management (for example, electrical energy), which comprises:

- A group of electricity meters where each meter in the group of meters comprises:
  - Means for measuring and storing information on the consumption and/or generation of energy of at least one facility, periodically according to a first period of time;
  - Means for receiving a message requesting information from a communications node;
  - Means for sending said information to a control unit when an information request message is received from the communications node;
- The communications node configured to communicate a control unit bidirectionally with the group of meters (through at least one telecommunications network);
- The control unit comprises:
  - A processor configured to:
    - Periodically send, according to a second period of time, through the communications node, an information request message on the energy consumption and/or generation to at least one meter in the group of meters;
    - Receive, through the communications node, a message with information about energy consumption and/or generation measured and stored by at least one meter in the group of meters during the second period of time;
    - For every meter in the group of meters from which information has been received, process the information about energy consumption and/or generation received from the meter (if any) to determine the activation of an alarm depending at least on the information about energy consumption and/or generation received from the meter;
    - If the activation of an alarm is determined for one of the meters of the group of meters, send an alarm message through the communications node (for example, via email or SMS) to an electronic device of at least one user associated to said meter;
- Means for displaying to at least one user of the system through their user interface at least part of the information on energy consumption and/or genera-

tion received from the at least one meter of the group of meters (for example, this user can be an user associated with at least one of the meters of the group of meters from which information is received).

[0008] The communications node can be co-located with the control unit or it can be in a different location from the control unit and communicate with the latter via a communications network.

[0009] The communications network can communicate with each of the meters via a mobile phone network, modem or router and can use different communications technologies to communicate with the different meters in the group.

[0010] The user interface can be located in the electronic device of the user that may be a smart phone, a tablet, laptop or any type of electronic device. This user interface can be a specific application installed in the user's electronic device or a web page accessed via the user's electronic device.

[0011] Said first and second period of time may have any value. For example, the first period of time may be 15 minutes and the second period of time may be one or several hours, one or several days or one or several weeks.

[0012] The information on energy consumption and/or generation may include consumption curves (or generation curves) for each first period of time of any other type of energy consumption and/or generation information.

[0013] In one embodiment the processor is also configured to:

- Obtain the contracted power (for example electrical energy) and/or rate that minimises the energy consumption cost in a particular time interval, from at least one meter or sub-group thereof, from the information on the consumption and/or generation received from at least one meter or sub-group thereof.

[0014] Obtaining the contracted power and/or rate that minimises the cost may involve:

- Calculate, from the information on consumption and/or generation, in the given time interval, received from at least one meter or sub-group of meters, the cost of the energy consumption for the at least one meter or sub-group of meters, for different values of contracted power and/or rate;
- From the above calculation, select the contracted power and/or rate that minimises the cost of the energy consumption of each meter or sub-group of meters.

[0015] In one embodiment the processor is further configured to calculate, from the consumption information received from the different meters and information about the contracted rate and power, the cost of the electricity consumption of each meter or sub-group of meters.

[0016] In one embodiment the control unit further comprises means for receiving from at least one user of the system (for example, through his user interface), a request of the information the user wants to be displayed and of what time interval and where the display means shows the information from the meters to at least one user of the system according to the requirements included in that request.

[0017] The information shown to the user of the system can be at least one of the following:

- Maximum value of the power demand during the time interval;
- Consumption and/or generation curves from one or more meters during the time interval;
- Absolute or incremental total values of active and reactive energy consumption during the time interval;

The information on power consumption measured and stored by the meters may comprise at least one of the following parameters:

- Active Energy Import
- Active Energy Export
- Reactive energy quadrant 1
- Reactive energy quadrant 2
- Reactive energy quadrant 3
- Reactive energy quadrant 4

[0018] In one embodiment, each meter additionally comprises means to measure and store data from the end of the energy consumption and/or generation billing cycle and the control unit is additionally configured to periodically send a message at the end of each billing cycle requesting the end of billing data from each meter in the group of meters and to receive, through the communications node, a message with data of the end of the energy consumption and/or generation billing cycle for each meter of the meter group.

[0019] The information request message sent by the control unit may only require from at least one meter the data not previously received from said at least one meter. If there is a communication problem while receiving information from the meters, the control unit can resubmit a consumption request to the meter to send only the data not received.

[0020] In another aspect of this invention a unit for energy control and management is presented, which comprises:

- A processor configured to:
  - Send periodically every second period of time, through a communications node configured to communicate the control unit bi-directionally with a group of meters, a message requesting information on energy consumption and/or gen-

eration to at least one meter in the meter group;

- Receive, through the communications node, a message with information about energy consumption and/or generation measured and stored by the at least one meter in the group of meters, each first period of time, during this second period of time;
- For every meter of the group of meters from which information has been received, determine the activation of an alarm depending on at least the information about the energy consumption and/or generation received from each meter;
- If the activation of an alarm is determined for one of the meters of the group of meters, send an alarm message through the first communications node to an electronic device of at least one user associated to that meter;

- Means for displaying to at least one user of the system through his user interface at least part of the information on energy consumption and/or generation received from the group of meters.

[0021] Another aspect of the present invention presents a method for energy control and management, where the method comprises the following steps performed by a control unit:

- Periodically send each second period of time, through the communications node, a request message on the energy consumption and/or generation from at least one meter in a group of meters;
- Receive, through the communications node, a message with information about energy consumption and/or generation measured and stored by each meter in the group of meters, each first period of time, during this second period of time:
- For every meter of the group of meters from which information has been received, determine the activation of an alarm depending at least on the information about the energy consumption and/or generation received from each meter;
- If the activation of an alarm is determined for one of the meters of the group of meters, send an alarm message through the first node of communications to at least one user associated to said meter;
- Displaying to at least one user of the system through his user interface at least part of the information on energy consumption and/or generation received from the group of meters.

[0022] Finally, in another aspect of the invention, a computer program is presented, comprising computer executable instructions for implementing the method described, when executed on a computer; digital signal processor; an application-specific integrated circuit implementation; a microprocessor; a microcontroller or any other form of programmable hardware. Said instructions may be stored in a digital data storage medium.

[0023] The following specification and accompanying drawings can be used as reference for a more complete understanding of the invention, its objectives and advantages.

DESCRIPTION OF THE DRAWINGS

[0024] To complement the description provided herein and for the purpose of aiding in a better understanding of the characteristics of the invention, according to a number of preferred practical embodiments thereof, a set of drawings is attached as an integral part thereof, wherein, by way of non-limiting examples, the following has been represented:

Figure 1 schematically shows an architecture, by way of example, of the proposed system according to an embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0025] The present invention proposes an intelligent method and system for the control and management of energy consumption/generation, and more specifically electricity (although it can be applied to any other type of energy). The system (also known as platform) proposed enables this control and management by periodically downloading data (e.g. periodic curves) for each of the different meters that measure the power consumption (or generation) of each of the supplies.

[0026] The period in which the meters record the consumption data (or electrical energy generation data, if applicable) is a configuration parameter, but for appropriate control and management the recommended interval should not be very high (for example, every 15 minutes, although of course other data collection periods are possible). This data capture at relatively small intervals enables detailed and continuous readings to be obtained of the consumption/generation, thus enabling the facility's consumption/generation patterns to be realistically determined in order to optimise them (which cannot be achieved by other existing systems that receive the consumption measured by the different meters once a day or even once a month). Thus, in one embodiment of the invention, the meters used always read and store the data (for example the load curve) every 15 minutes enabling much more data to be gathered (and therefore more detailed information) than in the existing systems, where the readings occur at longer intervals.

[0027] The meters can have a memory (buffer) that stores the data for a certain period of time until downloaded by the platform, meaning that the frequency with which the data is downloaded from the meter does not need to match the data collection interval, which can be longer. Thus the meters are able to store data for a long period of time, for example 3 months, and accordingly no data would be lost when downloading data every 3

months. However, to see the real evolution of this consumption data and have the most up-to-date information possible, it is advisable for the download interval not to be so long. The download interval is a parameter configured by the user of the platform, but for adequate control the minimum recommended interval is once a day, or even more frequently. In other words, although the meters collect data every 15 minutes, it does not need to be downloaded from the meters with that interval, and instead the meters store the data every 15 minutes and a system node (communications node) will download that data in the desired time interval (for example, every day).

[0028] The downloaded data can be saved in the appropriate format (for example, Excel or any other format) for the appropriate analysis, enabling the data to be graphically displayed for easier interpretation by the user. The platform can also incorporate a rate (fees) calculator that, based on the rate and downloaded consumption data, calculates the actual bill for a particular time period and calculates what the optimal power supply should be in order to reduce the cost to a minimum. Additionally, an alert system can be activated (for example, via SMS, email, through a specific application for mobile devices, through a web interface or application or any other communications tool) to an electronic device belonging to the user, if the different consumption parameters exceed a predetermined value thresholds (configured, for example, by the user of the system).

[0029] The system enables the control and management of the electricity consumption in a particular facility or set of facilities (companies, homes, commercial establishments or any other type of facility) where there are appliances that consume electricity. Each facility will have one or more power consumption meters that measure the power consumption of one or more devices at the facility. In other words, there may be a meter that measures the consumption of a set of devices at that facility or of all the devices (in which case, there will be one meter per facility) or there may be meters that measure the consumption of only one device. In any case, the system will periodically download the consumption curve measured by the meters of the facility or facilities it controls. The system will normally be used for the control and management of non-domestic consumption, which means in that case, the meters will be meters for measuring non-domestic power loads. However, the system may also be used for domestic installations and in this case the meters will be meters for measuring domestic power loads. One of the embodiments may even use meters of both types according to the appliances for which the consumption is being read.

[0030] System users can be any person who is authorised to access the electrical energy control and management system of a given facility or set thereof. For example, the person(s) responsible in the company or factory for managing power consumption at the factory (if the facility is a company or a factory), or the homeowner (in the case of a home), etc.

[0031] The interaction between users and the system will be through the user's electronic device (such as a smart phone, a tablet, laptop or any type of computer), through an appropriate user interface. Any tool can be used that allows data to be entered and displayed to the user, such as for example a specific application developed for the electronic device or a web page designed for that purpose. Using this interface, the user can introduce the required data (for example, data of the equipment whose consumption must be controlled/managed, both in terms of its supply characteristics and data connection); the rules for determining anomalies can also be modified, indicating what type of alerts or alarms the user would like to receive, how they will be received (for example, if users want to receive them via a telephone message, they will have to enter the mobile phone number on which they want to receive messages, or their email address if the chosen method is email). This information will be sent by the electronic device (via the application or website) to the platform (for example, the central server or control unit thereof), which will process the data so that the operation is appropriate and in accordance with the user's wishes.

[0032] Security policies can be established (using any known method, such as with username and password) with different permissions for different users to access certain data, as well as programming general rules to limit the information that can be accessed and the changes that can be made, depending on the user in question. Unauthorised users can also be prevented from accessing said information.

[0033] The system will also present the data collected from the user on their electronic user device (through, for example, an application or a web page). Users can choose what data they want to see and how. For example, there may be dropdown menus where the users can choose what data they want displayed, how the data is viewed and the time period they want to see on the screen. For example, the user's electronic device can display a graph showing the peak consumption and demand of supply (maximum value of the electrical power demand in a period of time), where the user can see what the values are for each point on the graph by passing the cursor over the graph. Or the user can display the total consumption values (absolute and incremental) of active and reactive energy, peaks and excesses of power that were recorded by the meter in a given period of time.

[0034] Internally, the system selects from among the data downloaded (e.g., consumption curves for every hour or quarter-hour in a given period of time) for all the meters managed, the data requested by the user, using appropriate filters and relevant libraries to display the graphs or data required. The system can also validate dates; for example, if the user selects data to be shown over an excessive time period (reducing the speed of the application), an alert can be sent to the user informing them of this fact.

[0035] For example, the user can also request, for a

defined period of time, a simulation of the power bills for the months in that period. This bill will be prepared using actual consumption data downloaded from the meters and the preselected rate and power. From now on, and to reduce the cost of these bills, the user can modify both the values of the contracted powers and rates to see how the amount billed varies on the basis of these parameters. This can also be performed automatically by the tool, if the user so wishes (for example by selecting an option to "Optimise contracted capacity" or "Optimise contracted rate") and the proposed system will apply an optimisation algorithm that will aim to seek the optimal power (or rate) options in order to minimise the total cost of the bill in a specific time interval (for example, applying different options of contracted power and/or rate to the actual consumption data, until a power and/or rate combination that results in the lowest bill in the time period defined is achieved).

[0036] To do this, in the case of optimising contracted power, the proposed system will simulate (via software) the electricity bill of each of the supplies, in a time period, and varying the contracted power, taking into account that it is sometimes advisable to contract less than the peak demand value detected (maximum value of the electrical power demanded during a period of time) which can lead to benefits when the surcharge for exceeding peak demand is potentially compensated for by paying less in terms of power. The software calculates both the power and consumption aspects of the bill, either according to peak demand or excess power. In one embodiment, the optimisation algorithm used first searches for the peak demand of each of the rate periods (e.g., one month) with the rate being simulated, and then simulates the bills for the entire pre-set time interval (e.g., month by month) and keeps the total estimated cost of those bills. Then, the contracted power is decreased, in a first period of the interval (configurable) and all the bills are recalculated and, if the estimated cost is less, the power is decreased until it reaches 0 or when the cost increases with respect to the previous cost. Once the contracted power has been found for the first period, the process is repeated for the second period, decreasing the value of the contracted power while the bill decreases, but with the difference that the value of the power to be contracted in the second and subsequent periods must be greater than the value of the power in the previous period (in all the rates except rate 3.0 since this rate does not require the power to comply with the correlation that a period must be greater or equal to the previous one). Once the optimal value for the second period has been found, the third period will be processed with the same criteria as for the second, and so on until the last period of the interval.

[0037] The system normally focuses on two types of user: the manager user, who can only configure certain parameters (with access only to certain configuration screens) and who can control and manage only certain meters/facilities for which permission has been granted (for that facility or the facilities managed); and the administrator user of the tool who can access all the configuration screens and configure any setting and who can control and manage all the available meters (who will be the person responsible for the maintenance of the system). The administrator user, can for example, manage and edit the different devices, rates, user profiles, periods, configure holidays, establish the general configuration for calculating the bill such as electricity taxes, penalty surcharges for excess consumption, etc.

[0038] Figure 1 represents the architecture of the system proposed according to one embodiment of the invention. First there is set of meters to measure the power consumption to be managed. Although the proposed system can manage a single meter, in general, one or more groups of meters will be managed. Each meter can measure the power consumption of a machine or appliance in particular or a set of machines or devices in a given installation. These meters can be of any known type, with the specific requirement that they should have a communications module to allow remote reading.

[0039] Each meter (or group thereof) will have one or more associated users (duly identified) in the system (usually in the control unit). This user (or users) associated to a meter will be the user who has access to the data reported by the meter, and who will receive a warning if there is an alarm associated with data reported by that meter and for which the user can at least partially configure the data managed by that meter (presentation of data, alarms generated, etc.).

[0040] These meters will communicate with a communications element (node) (called the remote communications platform, communications module or unit, auxiliary server or simply "remote communications node"), which will be in charge of gathering the data from the different meters, either via a data telephone call, using an IP connection or by using any other type of known communications technology (wired, wireless, modem, 2G, 3G or 4G mobile communications, fibre optic, etc.). In other words, this element is responsible for contacting the meters (managing calls to them or in general, the communications with them) to download the data captured by the meters. Any known communications protocol may be used for the communications between this element and the meters. In one embodiment the protocol used is IEC 870-5-102.

[0041] Said communications element can be a server, personal computer or in general any type of electronic device that enables communications to be conducted with the different meters.

[0042] In one embodiment, the remote communications node will contact (sending a data request message) the meters regularly (in the period established during the initial configuration) in order to retrieve the data stored in them. In an alternative embodiment, the meters can send the data periodically to the remote communications node without having previously received a request from said node.

[0043] The data reported by the meters is the electrical energy consumption data. This data can be any of the known types. In one embodiment the data reported includes one or more of the following (in one embodiment the meters report all data from the following list):

- Active Energy Import (power consumed)
- Active Energy Export (power exported, if there is power generation)
- Reactive energy quadrant 1 (inductive reactive power consumed)
- Reactive energy quadrant 2 (capacitive reactive power consumed)
- Reactive energy quadrant 3 (inductive reactive power generated)
- Reactive energy quadrant 4 (capacitive reactive power generated)
- Winter/Summer (if the meter is in the winter or summer period)

[0044] This is just an example and the meters may report other types of consumption and/or generation data.

[0045] The meters can communicate individually with the remote communications node, but to streamline the communications, meters can be grouped depending on various criteria (for example, making a group of meters that are in the same facility or building). Figure 1, for example, shows N groups of meters, each of which communicates via a modem (although in another embodiment, several of these groups can use the same modem) with the remote communications unit (communications node), while there is a group of meters that communicates with the node via internet and the corresponding router using IP communications. Of course, even if the meters in Figure 1 are grouped, the communications node can also communicate with each meter in the group separately.

[0046] The remote communications node will also have the capacity to communicate with the users' electronic devices (mobile phones, computers, etc.) to transmit the different alerts that may arise to them (via SMS, email or any other mechanism), according to the configuration settings previously entered by the user. For example, an alert message (alarm) can be sent to the user if the maximum value of power demand during a period of time exceeds (or approaches) the maximum value of power contracted or an alarm can be sent if any anomaly in the power factor is detected. Thus the optimum power factor (e.g. cosine phi) is 1; if the power factor strays from more than a certain threshold from this optimal value (e.g., below 0.95) then an alarm would be generated since a power factor that is too low may indicate a problem in the electrical system that could lead to an increase in consumption, and therefore in the cost, for the reactive power at the facility. In Figure 1, for example, the communications node will use a modem (warning modem) to send the SMS notices to the mobile phones of the various users (although it may also have direct connection to a mobile phone network to do so) and a router to send emails to users by internet.

[0047] Thus the control unit (also known as the control and management platform or central server) where the remote communications node downloads the data from the different meters, will analyse this data and if the analysis detects that one of the alarm conditions stored on the central server arises, then the central server will order the remote communications node to send an alarm message to the appropriate user for this alarm (for example the user associated to the meter where this alarm has occurred). The alarm message will include information on the same (for example, the reason for the alarm, the time it happened, the equipment affected, etc.). This communication can be performed for example through a mobile phone network or any other type of communications network.

[0048] Once the data from the different meters has been read (downloaded) by the communications element, it will be dumped (i.e. sent) and sent to a control unit (central server). In the example in Figure 1, the communication with the central server is performed via the Internet (by using a router for example) but generally speaking any communications technology can be used to communicate this communications element with the central server. For simplicity in Figure 1, the same router is displayed to communicate the node of communications with the meters, electronic user devices or the control unit, but of course, this is just an example and, in another embodiment, the communications node may use different routers for each of these tasks.

[0049] The communications element may also be co-located with the control unit meaning that it will not have to communicate remotely with said unit to dump the data from the meters. Moreover, in another embodiment, the control unit will have direct communication with the meters, in which case, the communications element is not necessary as a separate element since the control unit will also perform the functions of the communications element (or in other words, the control unit will have the communications element built-in).

[0050] For simplicity, in the example there is a single control unit and one remote communications node, but there may be several control units and/or several remote communications nodes, each of which will manage different groups of meters.

[0051] The central server will manage the meters through a processor (or a set of processors) with controllers installed (also called drivers, which are normally on the central server but can also be installed remotely) that will be responsible for managing each group (sub-group) of meters.

[0052] Periodically (for example on a daily basis, at a previously-programmed time) or when the control unit (for any reason) wishes to download data, it will collect consumption data from the meters (each driver will be responsible for collecting data from its group of meters). To do so, there will be a record indicating the meters that

are active (i.e., from which data must be collected) and that will send a data request message to each of the active meters of each group (i.e., it will perform sequential pooling) to collect the relevant data from each meter. This message will be transmitted via the communications node; i.e., the central server will tell the communications node to send a data request message to the different meters, which will send the message to the meter, receive the data from the meter and dump it in the central server. As previously stated, although the data may be collected daily, the data collected is consumption data obtained by (and stored in) the meters for much shorter periods (e.g. every 15 minutes). In other words, although the data is downloaded daily, the consumption data is much more detailed over time (the consumption curves obtained are not daily, but for 15-minute intervals).

[0053] When it comes to collecting data from each device, not all the data is always requested, but instead only the curves which had not been collected before are requested, in order to optimise the collection time of the historical data. Similarly, if there is a communications problem during the data collection (between the meter and the remote communications node) there is no need to send all the data again, but instead, the server (or remote node) will request the meter to send the data from the point when the communications were cut-off (i.e., the data still not received from the meter).

[0054] Similarly, with a longer period of time (for example, at the beginning or end of the month), the control unit can also perform a sequential pooling of the meters to collect the end of month billing data. This data is recorded for each meter when the billing cycle is completed (usually monthly) and the data (values of the different rates, as peak power consumption and excesses, etc.) that the electrical company uses to generate bills.

[0055] In addition to the data collected in the central server, there is also a user interface that enables a user to act manually on the corresponding driver to force data readings (historical data stored or end of billing cycle) of one or more specific meter(s).

[0056] All the data collected from the meters (both the data stored every 15 minutes and the closure of billing) are stored in a database (on the central server or a remote database) for analysis/processing. In one embodiment the central server will use SQL language. Similarly, a record (log) of the connections made with the meters in each data collection period can be stored, which may show the characteristics of the communications performed (start time, duration, etc.) and any possible incidents encountered during the process. This connections log is stored in a database and can be sent (by e-mail) to the system user or administrator for analysis (for example, to detect malfunctions in any meter).

[0057] The collected data is analysed and processed for different purposes (among others, to optimise rates, optimise contracted power, detect consumption anomalies, etc.). In addition, as described above, as a result of this analysis various alarm messages can be sent to users (via SMS, and/or email and/or any other mechanism) according to the configuration settings previously introduced by the user. Thus, at each scheduled interval, the central server checks the data collected, and if it detects, for any of the meters in which the alarm warning is active, that the pre-configured alarm conditions are met (for example, exceeding the contracted power, abnormal power factor...) the server sends a notice to the user associated with this meter, informing the user of these circumstances. This alarm may include the identification of the meter, the time that it occurred, the cause and any other information that may be useful for the user.

[0058] These alarm conditions are fully configurable for each meter or group of meters; i.e., for each meter or group of meters, the user associated with the meter or group of meters (i.e., a user with permission to access them) can particularize the alarm conditions so that an event (for example, exceeding the contracted power 5 %) which generates an alarm if it occurs in one meter, does not generate the same alarm if it occurs in another meter. Users can also configure the type of alarm sent (SMS, email, both, etc.), the address to which they are sent, the information included or even configure the time range in which the notices of possible incidents can be sent to each user.

[0059] Although many of the embodiments shown here refer to the control and management of electrical power consumption and to the collection and downloading of consumption data, this is only one possible application, since, if there is electricity generation, the present invention can also be applied and it would cover not only the control and management of the consumption of electrical energy and the collection and download of consumption data, but simultaneously or alternatively, the control and management of the generation of electrical energy and the collection and download of generation data, as applicable, would also be possible. Likewise, although the embodiments shown refer to electrical power, this invention can also be applied for the control and management of any other type of energy (gas, wind, thermal, fuel, etc.).

[0060] Some preferred embodiments of the invention are described in the dependent claims which are included below.

[0061] In this text, the term "comprises" and its derivatives (such as "comprising", etc.) should not be understood in a limited sense, in other words, these terms should not be interpreted as excluding the possibility that what is described and defined may comprise more elements, stages, etc.

[0062] The proposed embodiments may be implemented as a collection of software elements, hardware elements, firmware elements or any appropriate combination thereof. A person skilled in the art will immediately recognise that the stages of the various procedures described above can be performed by programmed computers. In the present specification, some embodiments are also intended to cover program storage devices, e.g., digital data storage media, which are readable by ma-

chine or computer, and that code instruction programs, executable by machine or executable by computer, where such instructions perform some or all of the stages of the procedures described above. The program storage devices can include, for example, digital memories, magnetic storage such as magnetic disks and magnetic tapes, rigid disk controllers or optically readable digital data storage media. The embodiments are also intended to cover computers that are programmed to perform said stages of the procedures described above.

[0063] Having sufficiently described the nature of the invention, as well as some practical embodiments, it must be stated that its different parts can be manufactured in variety of materials, sizes and shapes, and that its embodiments or operation can also comprise practical variations, provided that such variations do not alter the fundamental principle of the present invention. The description and the drawings merely illustrate the principles of the invention. Therefore, it must be understood that the persons skilled in the art may devise certain arrangements that, although they have not been described or shown explicitly in this document, reflect the principles of the invention and are included within its scope. Furthermore, all the examples described in this document are provided mainly for pedagogical reasons to help the reader to understand the principles of the invention and the concepts provided by the inventor(s) to improve the art, and should not be considered limited with respect to the examples and conditions described in a specific manner. In addition, all of the foregoing concerning the principles, aspects and embodiments of the invention, as well as the specific examples given, also extend to any equivalents thereof.

[0064] Although this invention has been described with reference to specific embodiments, persons skilled in the art must understand that any changes, omissions and additions in the shape and details thereof described above can be made without departing from the scope of the invention as defined by the following claims.

Claims

1. A system for energy control and management, which comprises:

- A group of electricity meters where each meter in the group comprises:
  - Means for measuring and storing information on the consumption and/or generation of energy of at least one facility, periodically according to a first period of time;
  - Means for receiving an information request message from a communications node;
  - Means for sending said information to a control unit when an information request message is received from the communications node;
- The communications node configured to communicate a control unit bidirectionally with the group of meters;
- The control unit comprises:
  - A processor configured to:
    - Periodically send, according to a second period of time, through the communications node, a request message of information on the energy consumption and/or generation to at least one meter in the group of meters;
    - Receive, through the communications node, a message with information about energy consumption and/or generation measured and stored by the at least one meter in the group of meters during said second period of time;
    - For every meter of the group of meters from which information has been received, determine the activation of an alarm depending on at least the information about the energy consumption and/or generation received from the meter;
    - If the activation of an alarm is determined for one of the meters of the group of meters, send an alarm message through the first communications node to an electronic device of at least one user associated to said meter;
  - Means for displaying to at least one user of the system through his user interface, at least part of the information on energy consumption and/or generation received from the at least one meter from the group of meters.

2. The system according to claim 1, where the communications node is co-located with the control unit.

3. The system according to claim 1, where the communications node is in a location other than the control unit and communicates with the latter over a communications network.

4. The system according to any of the previous claims, where said first period of time is 15 minutes.

5. The system according to any of the previous claims, where the information on energy consumption and/or generation includes consumption and/or generation curves for every first period of time.

6. The system according to any of the previous claims, where the processor is additionally configured to:

    - Obtain the contracted power and/or rate that minimises the power consumption cost in a given time interval, for at least one meter or sub-group thereof, from the information on the consumption and/or generation received from the at least one meter or sub-group of meters.

7. The system according to claim 6, where said obtaining of the contracted power and/or rate that minimises cost, comprises:

    - Calculating, from the information on consumption and/or generation in the given time interval, received from the at least one meter or sub-group of meters, the cost of the energy consumption for the at least one meter or sub-group of meters, for different values of contracted power and/or rate;
    - From the above calculation, selecting the contracted power and/or rate that minimises the cost of the power consumption of each meter or sub-group thereof.

8. The system according to any of the previous claims, where said alarm message is sent through an email or an SMS to the user's electronic device.

9. The system according to any of the previous claims, where the control unit additionally comprises:

    - Means for receiving from at least one user of the system, a request about what information the user wants to be displayed and of what time interval; where the means for displaying shows the information from the meters to the at least one user of the system according to the requirements included in that request;

    and where the information shown to the user of the system is at least one of the following:

    - Maximum value of the power demand during the time interval;
    - Consumption and/or generation curves from one or more meters during the time interval;
    - Absolute or incremental total values of active and reactive energy consumption during the time interval.

10. The system according to any of the previous claims, where each meter additionally comprises:

    - Means to measure and store data from the end of the energy consumption and/or generation billing cycle;

    And where the control unit is also configured to:

    - Periodically send, at the end of every billing cycle, a request for end of billing data to each meter in the group of meters;
    - Receive, through the communications node, a message with data of the end of power consumption and/or generation billing cycle from each meter in the group of meters;

11. The system according to any of the previous claims, where the information request message sent by the control unit, only requests to the at least one meter, the data not received previously from that meter.

12. The system according to any of the previous claims, where the communications node communicates with each of the meters via a mobile phone network, using a modem or through a router, and where the communications node can use various communications technologies to communicate with the different meters in the group.

13. A control unit for electricity control and management, which comprises:

    - A processor configured to:

        - Send periodically every second period of time, through a communications node configured to communicate the control unit bi-directionally with a group of meters, a message requesting information on energy consumption and/or generation to at least one meter in the meter group;
        - Receive, through the communications node, a message with information about energy consumption and/or generation measured and stored by the at least one meter in the group of meters, each first period of time, during this second period of time:
        - For every meter of the group of meters from which information has been received, determine the activation of an alarm depending at least on the information about the energy consumption and/or generation received from each meter;
        - If the activation of an alarm is determined for one of the meters of the group of meters, send an alarm message through the first node of communications to an electronic device of at least one user associated to said meter;

    - Means for displaying to at least one user of the system through his user interface at least part of the information on energy consumption and/or generation received from the group of

meters.

14. A method for energy control and management, where the method comprises the following steps performed by a control unit:

- Periodically send each second period of time, through a communications node, a request message on the energy consumption and/or generation to at least one meter in a group of meters;
- Receive, through the communications node, a message with information about energy consumption and/or generation measured and stored by each meter in the group of meters, each first period of time, during said second period of time:
- For every meter of the group of meters from which information has been received, determine the activation of an alarm depending at least on the information about the energy consumption and/or generation received from each meter;
- If the activation of an alarm is determined for one of the meters of the group of meters, send an alarm message through the first node of communications to at least one user associated to said meter;
- Display to at least one user of the system through his user interface at least part of the information on energy consumption and/or generation received from the group of meters.

15. A computer program, which comprises computer executable instructions that cause a computer executing the program to implement the method according to claim 14.

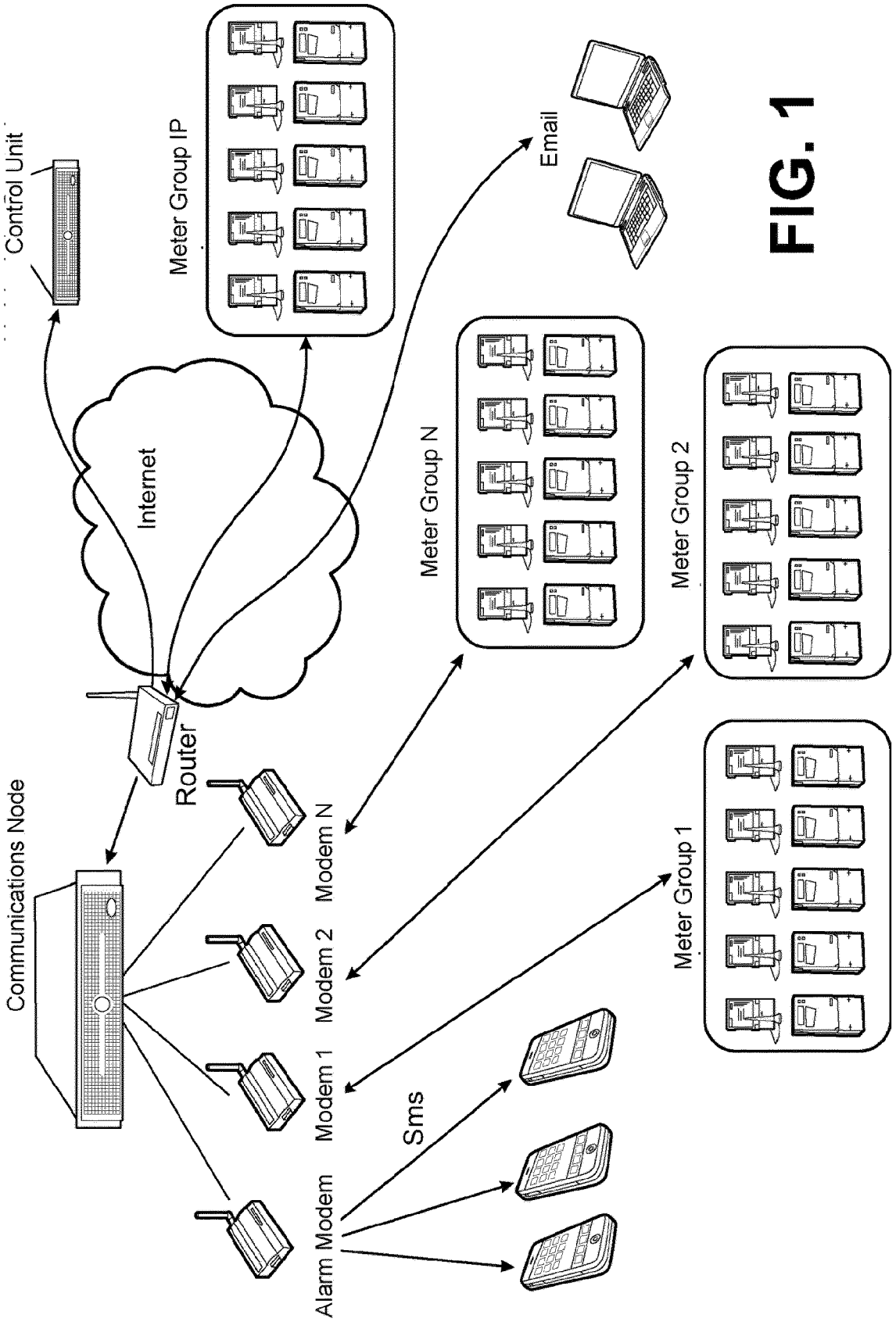
Control Unit
Meter Group IP
Email
Internet
Meter Group N
Meter Group 2
Router
Communications Node
Modem N
Modem 2
Modem 1
Alarm Modem
Sms
Meter Group 1

FIG. 1

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EUROPEAN SEARCH REPORT

Application Number
EP 15 38 2560

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2014/236508 A1 (MCGOWAN MICHAEL [US] ET AL) 21 August 2014 (2014-08-21) * abstract; figures 1-3 * * paragraph [0002] - paragraph [0012] * * paragraph [0018] - paragraph [0038] * -----	1-15	INV. G06Q50/06
X	US 2012/296490 A1 (FAUSAK ANDREW T [US] ET AL) 22 November 2012 (2012-11-22) * abstract; figures 1A-1B * * paragraph [0002] - paragraph [0004] * * paragraph [0016] - paragraph [0044] * -----	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

G06Q

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	15 April 2016	Fiorenzo Catalano, M

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15-04-2016

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82