United States Patent, Provisional
Tamarkin, et al **July 18, 2004**

Filed with USPTO via US
Mail Certified Receipt Requested

Invention

Real time utility service subscriber usage and billing information display and control, remote bi-directional data telemetry apparatus, system & method

Abstract

A system and method are provided for provision of real time, accumulated, and archived utility service commodity consumption and related billing information at a subscriber location supporting one or more utility services such as electrical, natural gas, bottled gas, oil, and water. Billing information such as rate structures and cost information is stored in the system. Remote communications may be established between the information display component of the system and various remote metrology devices used by the respective utilities to bill for said utility commodities. The display and control panel includes a communications means which allows bi-directional communications of data to and from various remote metrology components as well as a central location under computer control to relay data to and from a particular utility and the display and control panel. The control and display panel shall be governed by local software or embedded firmware with operating features and functions designed to allow for the real time measurement of a utility commodities use, the establishment of a usage budget, the control of utility service loads such as appliances, heating, ventilation, and Air Conditioning systems and the like. The display and control panel component of the system shall display usage information in engineering units and local monetary units as a product of cost and accumulated usage as well as graphic representations of commodity consumption, daily time, monthly time and in relation to the accumulated commodity consumption. A further object of the system is to provide the capability by the subscriber to download new screen formats and system functionality from time to time. Through periodic communications with a remote computer, the display and control panel shall be capable of providing the subscriber with an accurate bill at the conclusion of a utility billing cycle inclusive of tariffs, taxes, offsets, credits and other non commodity related charges. Further, the actual bill may be generated by a remote computer located at the utility or the bill may be generated by the subscriber side device with utility data base reconciliation interface.

Inventors: Tamarkin, Tom D., (Carmichael, California) Fine, Phillip M., (Sacramento, California) Block, Robert S. (Marina del Ray California)

Claims

What we claim:

1. A system for subscriber location in-home or in-office display of utility commodity cost and consumption information and control of utility commodity consuming devices; the system comprising:

(a) A remote display and control panel including microprocessor, memory, and related micro electronics, visual display element such as LCD, LED, CRT, Plasma, or such other display technology as is customarily used in conjunction with microelectronics based products, user interface such as a keypad or operatively grouped array of buttons, touch screen voice recognition, or other user interface technology customarily used in conjunction with consumer electronics products, a wireless bi-directional communications circuit capable of passing data to and from the display and control panel from a myriad of external devices such as electric meter, gas meter, water meter, oil or gas tank level sensor, temperature sensor, relative humidity sensor, appliance power sensor and a remote computer either through direct connection or through an intermediary system component serving as a communications gateway.

(b) A remote display and control panel containing all the attributes of 1(a) capable of processing data received from a plurality of electric, gas and water meters and the like and processing said data such that the data mirrors the local display of such meters and is capable of performing mathematical calculations with the data such as computing the real time utility commodity consumption in selectable monetary units consistent with local currency.

(c) A remote display and control panel containing some or all the attributes of 1(a) and 1(b), collectively or independently, capable of accumulating instantaneous utility commodity usage through the use of onboard memory and correlating such accumulated value with real time to produce accurate accumulated use record and an accurate representation of the subscriber's bill as prepared by the respective utility.

(d) A remote display and control panel containing some or all the attributes of 1 (a) through (c), collectively or independently, capable of receiving, storing, performing mathematical operations on and displaying a multitude of data sets and data structures as generated by the plurality of communicating components comprising this system including a large range of tabular data originating from the electrical meter interface module.

(e) A remote display and control panel containing some or all the attributes of 1 (a) through (d), collectively or independently, and which is capable of calculating and displaying variable rate tariffs such as time of use, tiered accumulated, peak demand, dynamic pricing and real time pricing.

(f) A remote display and control panel containing some or all the attributes of 1 (a) through (e), collectively or independently, and which is capable of sending and receiving electronic control signals and digital electronic data by a wireless means such as radio frequency, power line carrier, infarred, etc., to and from a heating, ventilation and air conditioning thermostat outfitted with a suitable communications transceiver device.

(g) A remote display and control panel containing some or all the attributes of 1(a) through (f), and which is able to receive electronic data structures from a remote thermostat indicative of the

current temperature at the thermostat's location as well as transmitting control signals to the thermostat which are used to control the heating, ventilation, and air conditioning system's fans, compressor, and the like, for purposes of maintaining a subscribers budget; such control signals may result from the display panels internal microprocessor in reaction to the subscriber's preset budget or such control signals may originate from a remote computer, delivered over a wide area network, passed through the systems gateway, local area network, display and control panel, and on to the thermostat.

(h) A remote display and control panel containing some or all of the attributes of 1(a) through (g), and which is able to send and receive electronic data structures to and from a remote intelligent set-back thermostat such that the thermostat may be programmed using the keys and graphic user interface located on the display panel.

(i) A remote display and control panel containing some or all the attributes of 1(a) through (h), collectively or independently, and which is capable of receiving new screen formats and functionality through a communications connection to a remote computer.

2. A system for the subscriber side establishment of an utility commodity, such as electricity, gas or water, daily, weekly and/or budget which may be programmed by the consumer or a remote computer and which tracks the real time use of these various commodities and:

(a) Displays on a graphic panel various graphs in bar graph or other suitable easy to understand style real time usage, accumulated usage, elapsed daily time in %, elapsed monthly time in %; the relationship of such bar graphs at any point in time serves to show the user the extent within which the budget is either met or exceeded.

(b) Generates an audible alarm notifying the user in real time if the established budget is in jeopardy of being exceeded; such alarm capability shall be user activated or deactivated.

(c) Generates a predicted end of month budget % as graphically displayed and a end of moth simulated bill.

3. A sub-component control module (figure 3) of 1 and 2 above, which is designed to be installed in several of the commercially available accumulated energy kWh electric meters and through an electronic interface with the meter's memory transfers data generally referred to as the ANSI table data to the components on-board solid state memory under control of a resident microprocessor which provides the following functions:

(a) Data logging and storage of time interval data for both the electric meter within which the device is installed as well as other external utility meters such as gas, water, and the like, communicating to the component by various wireless means such as radio frequency and other appropriate data transmittal techniques and with sufficient memory to maintain and archive a minimum of 45 days of 15 minute interval records for a minimum of three utility services such as electricity, gas, and water. Said data logging records may be transmitted to a remote computer on a scheduled or polled basis. The component shall be capable of communicating with a local hardware interface such as a photo-optical interface which may be used to retrieve the time

interval data through manual methods in the event communications to the remote computer is lost.

(b) The component shall contain a wireless transceiver using such techniques as radio frequency, power line carrier, infarred, etc., communications capable of transmitting and receiving data and control signals to and from the in-home information display as well as a local area network consisting of other utility meters such as gas and water, thus forming a communications path between the plurality of devices for which this component serves as the gateway.

(c) The component shall be capable of controlling an electric relay or contractor for purposes of establishing the flow of electricity or interrupting the flow of electricity to the subscriber under the control of a remote computer.

(d) The component shall be capable of relaying control signals to remote switching devices for purposes of interrupting or modulating an electrical load; said remote switching devices can be remotely located at the physical point of the switched load or may be located in an electrical breaker panel with an electrical connection to such remote loads.

(e) The component shall be capable of receiving electrical load metrics data from remote loads as defined in (d) above and manipulating this data for local storage in keeping with the overall system functionality and topology.

(f) The component shall serve as a gateway between remote devices as defined in (c,) (d,)and (e) above to allow for monitoring and control of such remote devices from the system in-home control panel for purposes of load reduction, prepayment of electrical service, etc.

4. An in-home display panel capable of displaying messages and other data in pixel based graphic format delivered over a wide area network:

(a) The in-home display panel shall allow for subscriber interaction by sending a response to the remote computer.

(b) The in-home display panel is capable of downloading information to an insertable ROM based Smart Card for the subscriber's download of electronic coupon, loyalty and credit information and the like.

(c) The in-home display panel is capable of uploading information from an insertable ROM based Smart Card for purposes of transferring prepaid utility credit for the plurality of utility services combined in the subscriber's local area network and which operate in conjunction with a service connect disconnect device such as a power contractor or relay or water gate valve.

(d) The in-home display panel is capable of decoding digital audio data, electronically amplifying said audio data, and annunciating said audio data through a self contained or external loud speaker of speaker system such that emergency notification of conditions such as safety threats, severe weather conditions, homeland security issues and the like may be delivered to

each subscriber over the wide area network twenty four hours a day, under the control of a remote computer.

4. A system consisting of the above components and functionality and which is capable of connection to a wide area network of either a fixed purpose such as a fixed network RF or Power Line Carrier system or a public access communications system such as a cable TV network, telephone, or cellular telephone network system.

(a) The in-meter component as defined in section 3 above may contain a modem device such as a power line carrier transceiver, cellular GPSR or the like which communicates directly to a fixed network or public access wide area network.

(b) The in-meter component as defined in section 3 above may communicate via wireless communications such as radio frequency or power line carrier with a remote interface device comprising a data transceiver and which in-turn provides an electrical interface to a wide area network such a cable TV (Set box converter) telephone or cellular modem and which may 1) serve to support one subscriber's local area network or 2) a multitude of subscriber's local area networks within the propagation range of said wireless circuit.

5. The various components as defined in sections 1 through 4 above operating singularly or collectively for the purposes set forth in the claims and abstract of this disclosure.

Background

As energy and utility service prices rise, increasing numbers of consumers are looking for ways to manage the amount of money spent on electricity, gas and water. The fundamental problem consumers have in managing their use of utility commodities, be it water, gas, or electricity, is that there is no practical way to tell how much of each product they are using and therefore how much they are spending at any point in time. Further, they do not know how much it costs to use a given appliance, maintain a certain household temperature, or water the lawn.

Utility companies have no way to know how much electricity, gas or water customers use in real time. They can not tell what the maximum peak amount of electricity, gas or water was used nor can they develop a corollary between time of service use and amount. The overwhelming majority of residential utility accounts are billed by taking an accumulation of services used over a thirty-day period of time. As a result of these metering limitations, consumers don't receive the benefit of flexible pricing options that more closely match their individual usage profiles.

Further, a utility typically obtains these accumulated monthly readings by sending a human meter reader to each and every account to visually inspect a local utility meter and manually record the readings in some type of hand held data terminal. Many residences have metered electric, gas and water services with local meters read once a month by different meter readers representing each utility service. This represents a significant cost to the utilities and their customers. There are also liability issues in these security conscious times.

Recent advances in microelectronics and communications technology have vastly outpaced the traditional installed means of metering, meter reading and billing. Today's technology can provide the consumer up to the second real time and accumulated energy usage and pricing information, provide the means to manage and control such usage, and automatically transport this information to multiple utilities such as electric, gas and water. The same technology provides the utilities significant positive economic advantages based on new control ability, reduction of operating expenses and new revenue streams resulting from new value added products and services. Further, new financing alternatives are created which eliminates the necessity of the utility having to pay for the acquisition costs associated with the new metering equipment. Cash strapped utilities can use these advantages to help return to profitability.

Description

The following diagrams, electronic schematics, and design specifications adequately articulate to those skilled in the art the construction of the disclosed invention.

Figure 1: A graphic representation of the invention's system in-home display referred to as the EMS-2020

Figure 2: A graphic representation of the invention's in-home display and explanation of the Energy Management and Budget Tracking mode of operation.

Figure 3: A graphic representation of the invention's in-home display and explanation of a user screen allowing for the subscriber's input of budget information.

Figure 4: A graphic representation of the invention's in-home display depicting the real time cost associated with the operation of a air conditioning system.

Figure 5: A photograph of the in-meter circuit board defined in claim 3, et al, designed to mount inside a Landis+Gyr "Focus" class 200 Killowatt hour meter.

Figure 6: A photograph of the in-meter circuit board defined in claim 3, et al, as installed inside a Landis+Gyr "Focus" class 200 Killowatt hour meter.

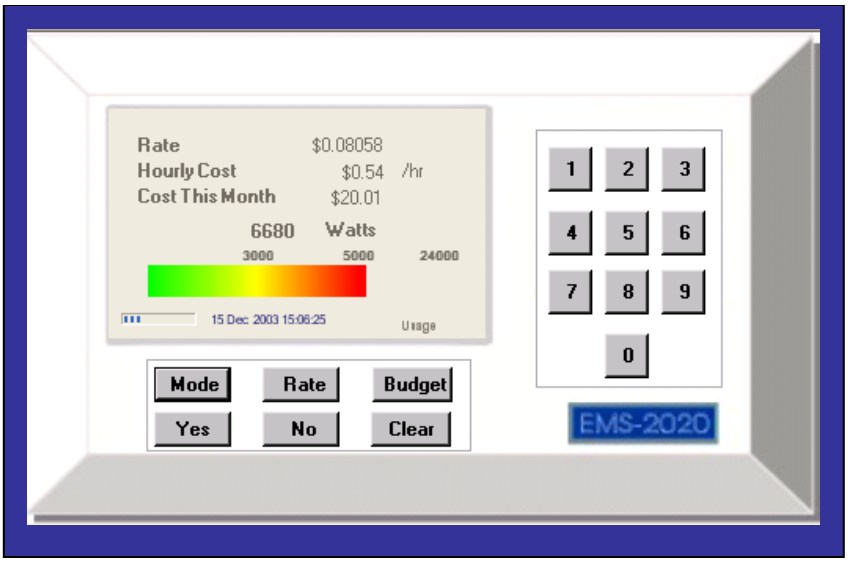
Figure 7: A photograph of the complete Landis+Gyr "Focus" class 200 Killowatt hour meter with the in-meter module defined in claim 3, et al, mounted inside.

Figure 8: A photograph of the in-home display printed circuit board top side.

Figure 9: A photograph of the in-home display printed circuit board bottom side.

Figure 10: A block diagram of the various components comprising the invention

The EMS-2020



Real-Time In-Home Energy Management System

Figure 2

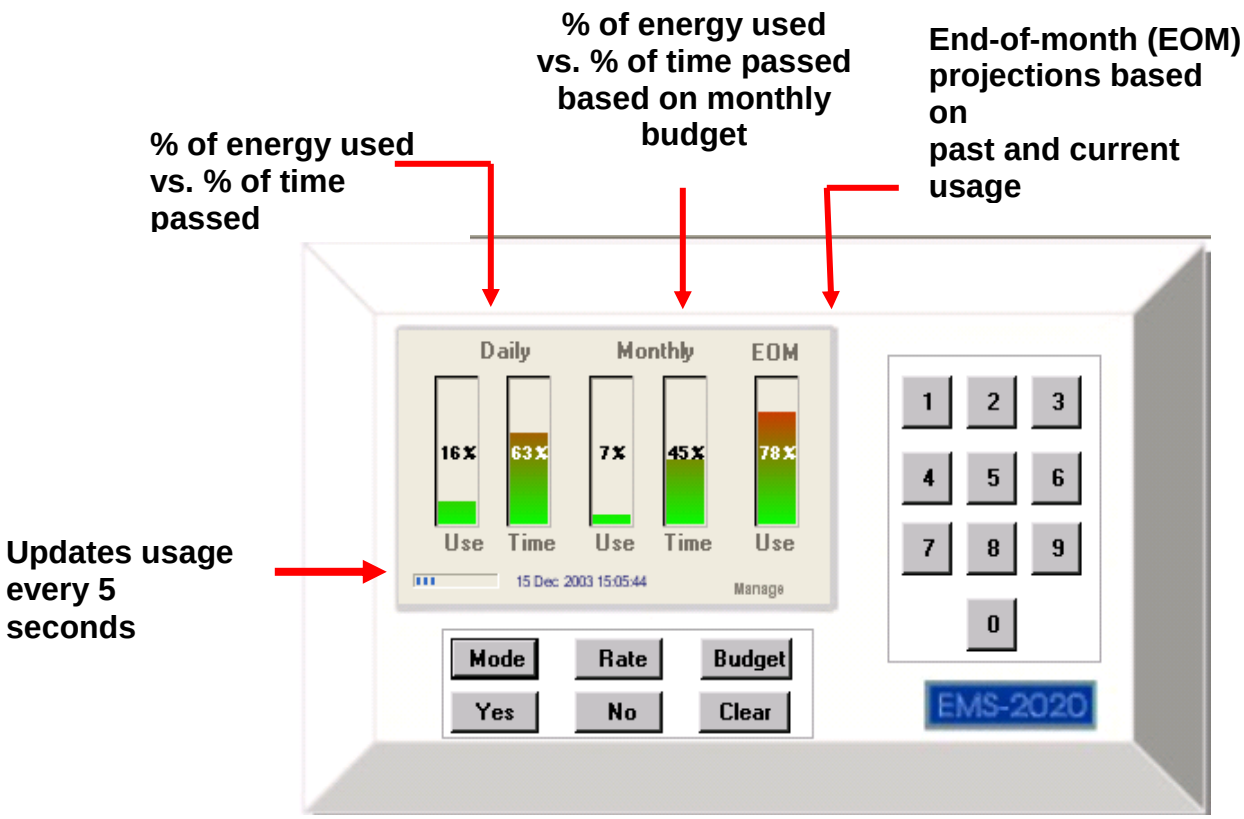


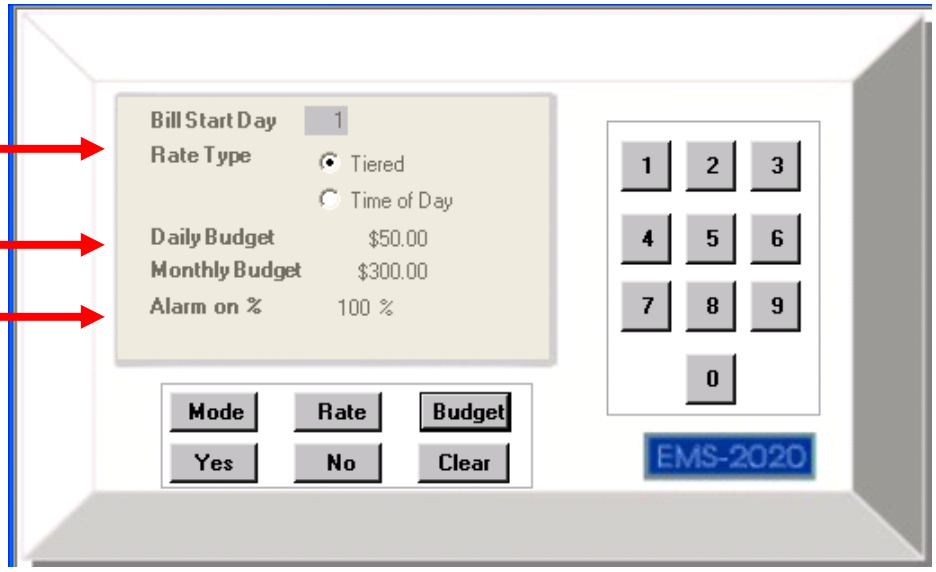
Figure 3

Consumer Driven Budgeting

Rate structure set by customer or utility

Customer controlled budget

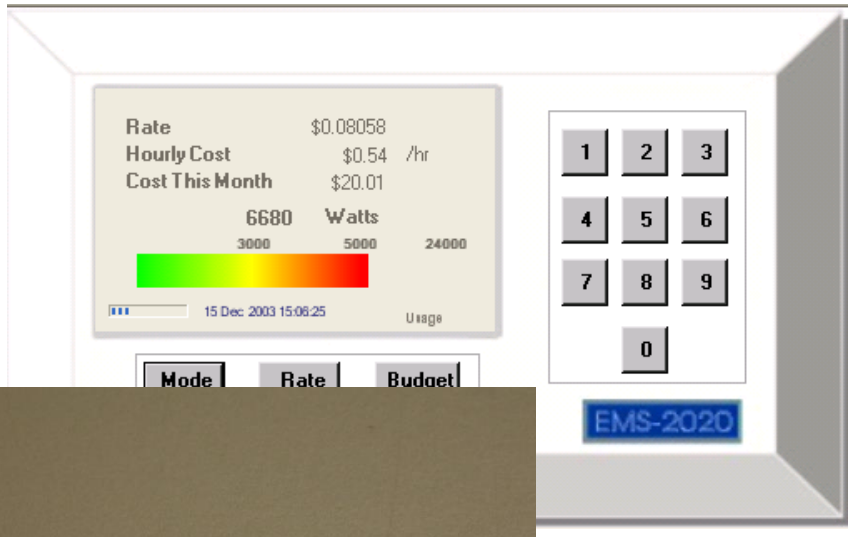
Customer controlled alarm sounds when EOM or bill is in jeopardy



Powerful budgeting software helps customers achieve their goals!

"Smart" Thermostat

Figure 4



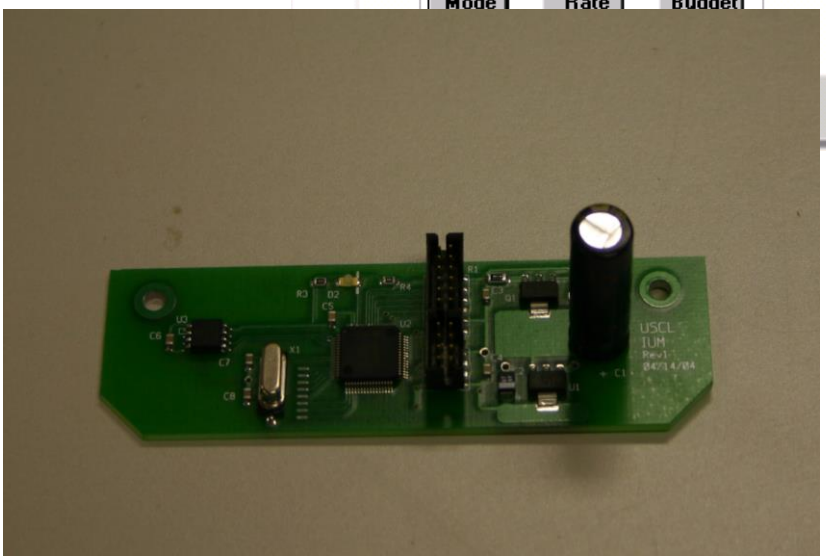


Figure 5

In meter circuit module as defined in Claim 3.

Figure 6

In-meter circuit control module as defined in Claim 3 installed inside a Landis+Gyr class 200 kWh meter.

Figure 7

Landis+Gyr class 200, solid state ANSI certified meter containing the in-meter circuit module as defined in Claim 3.

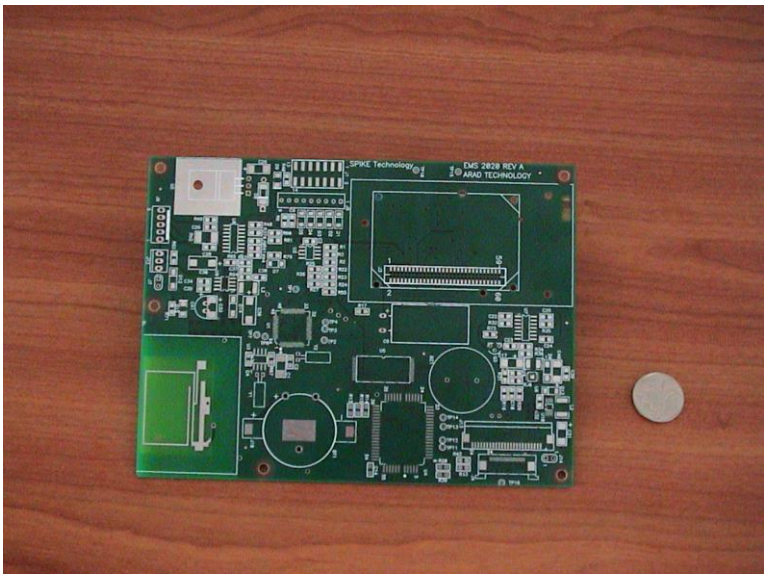


Figure 8

In-home display panel as defined in Claim 1, et al,. Electronic printed circuit board top view.

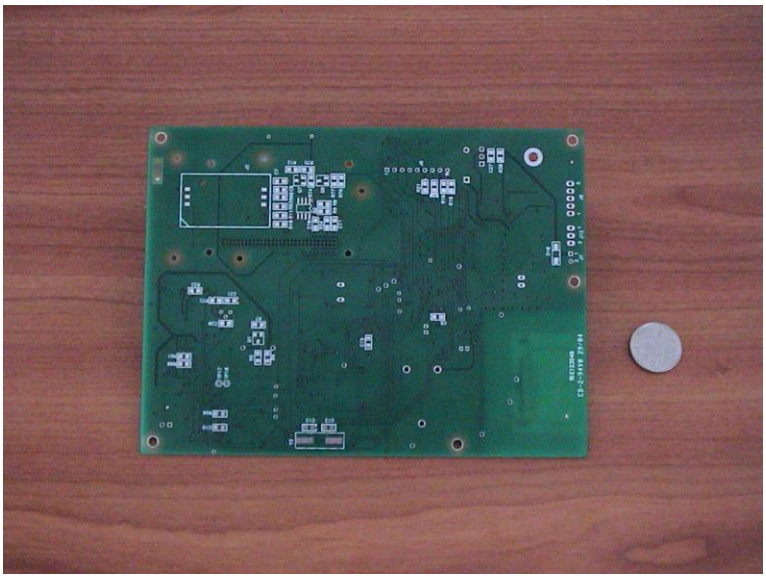
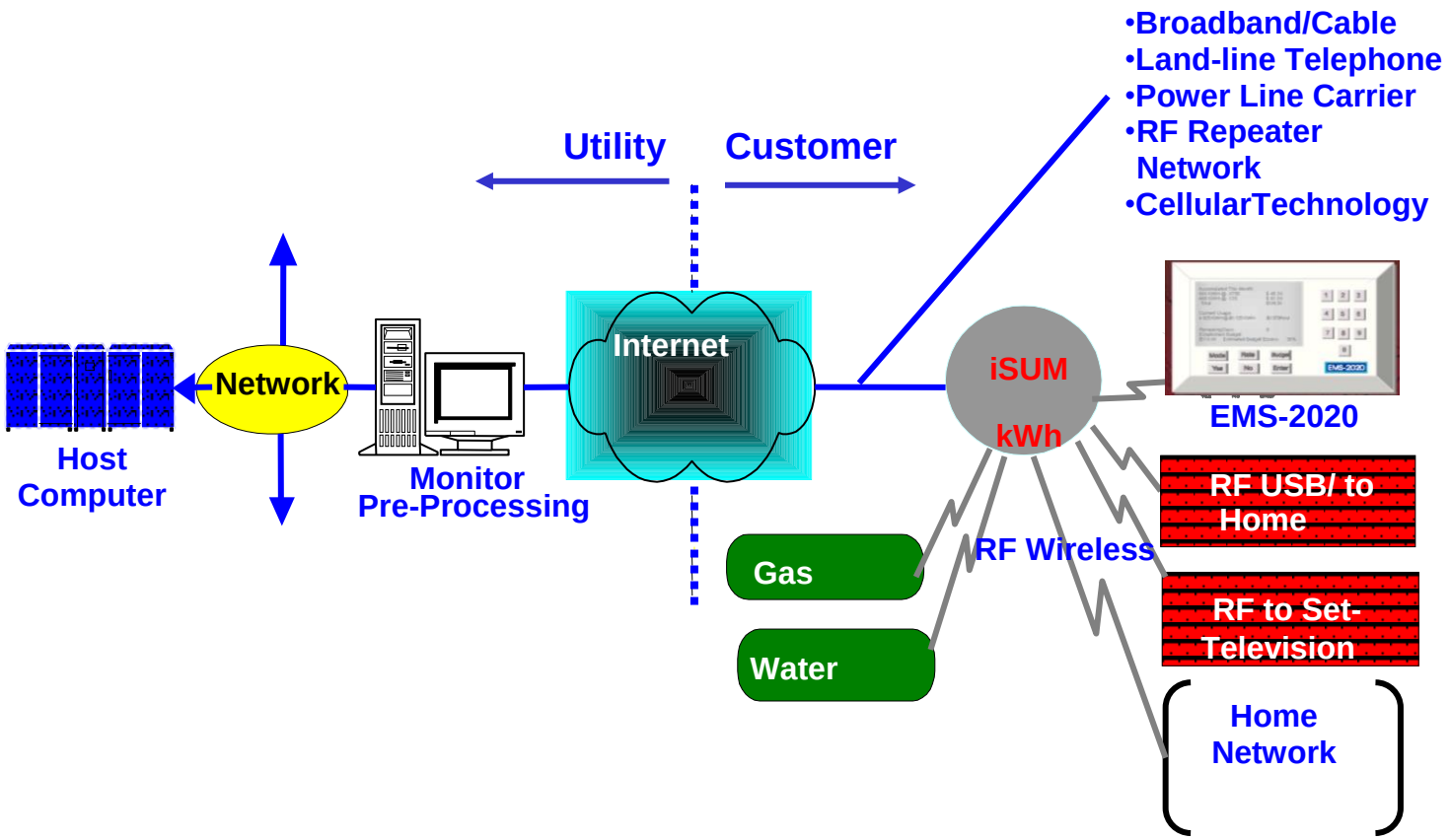


Figure 9

In-home display panel as defined in Claim 1, et al. Electronic printed circuit board bottom view.

Figure 10
System Block Diagram



Section II.

Real time utility service subscriber usage and billing information display and control, remote bi-directional data telemetry apparatus, system & method

Tamarkin, et al

A. Electronic Schematics of In-home display

B. In-Meter module Schematics

Section III.

Real time utility service subscriber usage and billing information display and control, remote data telemetry apparatus, system & method

Tamarkin, et al

Design Feature Function and System Topology Specification